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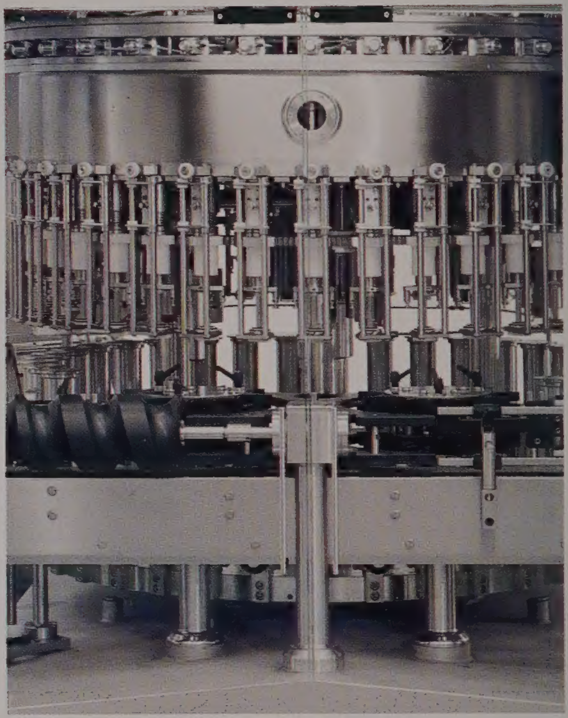

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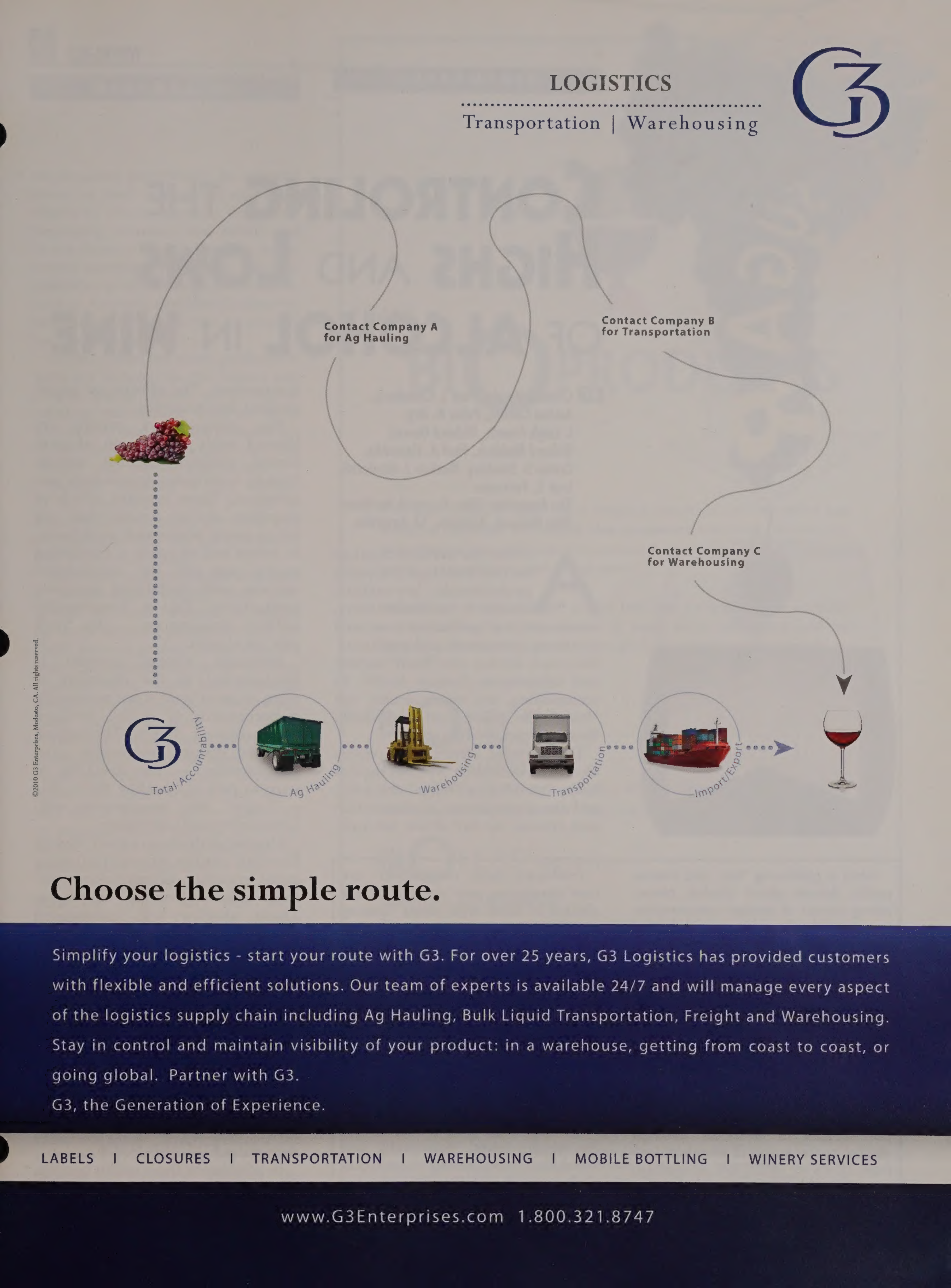
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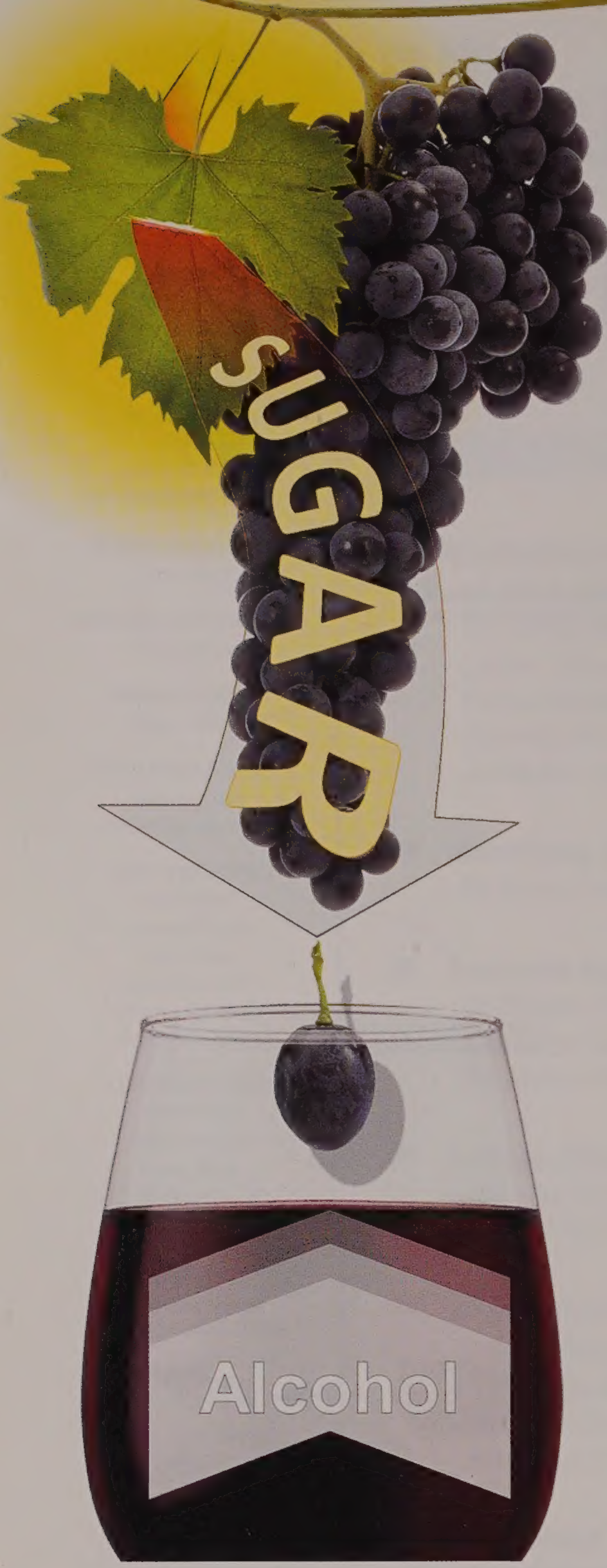

CONTROLING THE HIGHS AND LOWS OF ALCOHOL IN WINE

BY Cristian Varela, Paul J. Chambers,
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Amid a continuing "hot" and intense public debate about alcohol abuse, taking control of alcohol concentration in wine has become a priority for the wine sector worldwide. Despite a growing body of evidence indicating the health benefits of responsible, light to moderate wine consumption compared with other alcoholic beverages, wine is still much criticized in public discussion about alcohol abuse.

The challenge for the wine sector is how best to manage the "dark side" of alcohol worldwide and the "bright" side of wine and society. Over the past couple of decades, average alcohol concentration in wine has risen from 12.4% to 14.2% v/v. In contrast, consumer studies show that there can be a preference for lower-alcohol wines.

Producers and researchers are now developing new ways to reduce alcohol in some wine styles. Getting the balance right between alcohol concentration and body, with positive fruit flavors, can be surprisingly difficult. Options include changes to: viticultural practices (reducing leaf area, increasing irrigation in the pre-harvest period); fermentation and winemaking practices (selecting lower Brix grapes, use of yeast strains with lower fermentation efficiency); wine processing technologies (alcohol removal, lowering relative humidity for lengthy barrel maturation); and carefully considering consumer preferences when making higher alcohol wines.

All over the world, alcohol has become a hot topic for health professionals, law-makers, media commentators, economists, and politicians — as well as among consumers and producers. Too much alcohol can "burn" society and compromise human health. In winemaking, too much alcohol can "burn" the palate and overwhelm flavors in certain wine styles.

The harmful effects of excessive alcohol consumption, whether regular heavy drinking or "binge" drinking, and the consequences of intoxication and chronic alcohol abuse are well-documented. The effects are social, medical, and economic.

The daily news media are littered with articles on alcohol-fueled violence against family, friends, workmates, bystanders, and strangers. These harmful effects of excessive alcohol consumption are felt in many homes and workplaces, in streets and on roads — burdening health care and law enforcement services, and vandalizing economic productivity. This is irresponsible alcohol consumption – the "dark side" of alcohol.

Although alcohol content is fundamental to the character of wine, wine in itself is not necessarily a perpetrator of social, medical, and economic harm. Throughout civilized history, responsible wine consumption — the drinking of wine as part of a healthy diet — has a "bright" side, synonymous with conviviality and celebration.

More recently, the so-called "French Paradox" studies represent a tipping point, arguably differentiating wine from other alcoholic beverages. These studies and subsequent research showed that regular light to moderate wine drinking with meals may have health benefits for people in later life, in particular those who are at greater risk of cardiovascular disease.[23] There is mounting evidence that responsible wine consumption, embedded in healthy lifestyles, may reduce the risk of heart attacks, ischemic strokes, diabetes and certain cancers, as well as delay the development of dementias.[8,12,17,19,26,32,33,36]

In addition to these health benefits, the wine sector contributes positively to the economy, through income and employment particularly in regional areas, as well as through multiplier effects to other industries (including packaging, tourism, and retail) and to the balance of payments in major export earnings. Wine also helps to generate a positive image for countries such as Australia and New Zealand by being a stimulant for the hospitality and tourism sectors.

Indeed, when the many positives of wine are factored in, the heated and intense public debate about alcohol becomes increasingly complex as to how best to deal with the conundrum of the "dark side" of alcohol and the "bright" side of wine and society.

Indeed, alcohol is not unique in its complexity; life is full of examples of products, services, and technologies that can have negative and positive impacts.

As society seeks to grapple with such a "double-edged sword," wine will, despite its health benefits, be caught up in the ongoing debates around the "hot" topic of alcohol. Some lobbyists and commentators say, in the words of Thomas Fuller: "wine hath drowned more people than the sea." Fortunately, many more will agree with André Simon that "wine makes every meal an occasion, every table more elegant, every day more civilized." Different views from different sides — a "dark" side and a "bright" side — separated by personal choice and the (in)ability for taking personal responsibility for those choices. Moderation is key…

This debate, however, is more than the simple fact that wine contains alcohol. There is another equally heated debate about the concentration of alcohol in wine. Alcohol concentration in wine is increasingly becoming a "burning issue" for winemakers, wine writers, wine judges, wine connoisseurs, and casual wine drinkers alike.

Alcohol may be the backbone of wine, yet too much can make a wine off-balance. If in balance, "big" fruit-forward alcoholic wines are highly rated by some. Others bemoan the fact that high-alcohol wines can lack balance and elegance, "burning" the palate. Getting alcohol concentration and balance right with body and

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positive fruit flavors can, however, be surprisingly difficult.

> "Getting alcohol concentration and balance right with body and positive fruit flavors can, however, be surprisingly difficult."

Over the past couple of decades, average wine alcohol concentration worldwide has been reported to have risen from 12.4% v/v to 14.2% v/v. In Australia specifically, data collected by the Australian Wine Research Institute (AWRI) showed a steady increase in mean alcohol concentration for red wines from 12.4% v/v in 1984 to a peak of 14.5% v/v in 2005 with a plateau of this upward trend for the vintages 2006 to 2008.[15] For white wines, a similar but less dramatic increase was reported from 12.3% v/v in 1984 to a peak of 13.1% v/v in 2000, with a general leveling in concentration observed in subsequent years.

This trend toward wines having a higher content of alcohol is linked to wine styles having greater consumer acceptance. Wines that are rich, full-bodied, and have ripe fruit flavor profiles are facilitated by growing grapes in warmer and drier climates. Warm, dry climates minimize fruit deterioration and allow winemakers greater flexibility in choosing when to harvest, thereby supporting the production of wines with a greater range of flavors for many of our popular wine types.

The option to extend the time before harvest ("hang time" on the vine), which generally enhances the preferred flavor profile of wines, also leads to a higher total soluble solids level, including the sugar concentration, which in turn, leads to wines with high concentration of alcohol.

When out of balance, excessive alcohol concentration can negatively affect the sensory quality of wine. Furthermore, high alcohol content also increases costs to the consumer in countries where taxes are levied according to alcohol concentration.

> "When out of balance, excessive alcohol concentration can negatively affect the sensory quality of wine."

In recent years, the tendency worldwide for more frequent warm periods during the growing season has also increased the number of wines on the market with higher alcohol concentration. Producers of Pinot Noir in Burgundy or Riesling in Germany, where it was previously very rare to find elevated alcohol concentration, experienced some hot years recently

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(2003 and 2007) and produced wines with substantial alcoholic strength, up to 14.5% v/v.

Sensory effects and consumer preferences

While alcohol concentration is assumed by many to be an important driver of wine body and viscosity, there is little evidence to suggest that this is the case, at least in the range of alcohol concentrations typically encountered in dry table wines. What is clear, however, is that elevated alcohol concentration consistently results in increased palate warmth, or "hotness" in both red and white wines.[3,20]

Less clear is the effect of alcohol on wine aroma. While alcohol has been shown to reduce the sensory effect of some aroma compounds,[18] variations in alcohol concentration did not alter the perceived aroma intensity of either commercial white wine,[3] nor model wines to which a "wine realistic" aroma volatile mix had been added.[4]

OPPORTUNITIES FOR LOWERING ALCOHOL LEVEL IN WINE

VITICULTURAL PRACTICES

- Consider whether there is a relationship in your particular vineyard between leaf area and yields in lowering sugar concentration in berries and, if so, evaluate methods to decrease the leaf area/yield ratio in order to lower grape sugar concentration.
- Understand the relationship between grape flavor and final wine flavor, and consider if your berry sensory assessment is providing an accurate guide to the final flavor profile in wine.

FERMENTATION AND WINEMAKING PRACTICES

- Assess winemaking practices for fermentation of early-harvested lower-Brix grapes.
- Assess if the use of a lower-efficiency fermentation yeast strain, such as strain AWRI 796 (non-GMO) or equivalent is appropriate for your particular wine style.
- Understand how alcohol might be lost during fermentation due to factors such as open versus closed fermentors, and active pump-overs versus plunging or heading down.

WINE PROCESSING TECHNOLOGIES

- Where appropriate, utilize blending of high and low alcohol wine to achieve the desired final alcohol concentration, balance and quality.
- Consider whether engineering techniques to decrease alcohol in wine are appropriate for your production scale and wine style.
- If wine is to be kept in barrels for long periods of time, pay attention to relative humidity in cellar.

CONSUMER PREFERENCES AND TARGETED MARKETS

- Consider your market segment when producing wines with high alcohol concentration.

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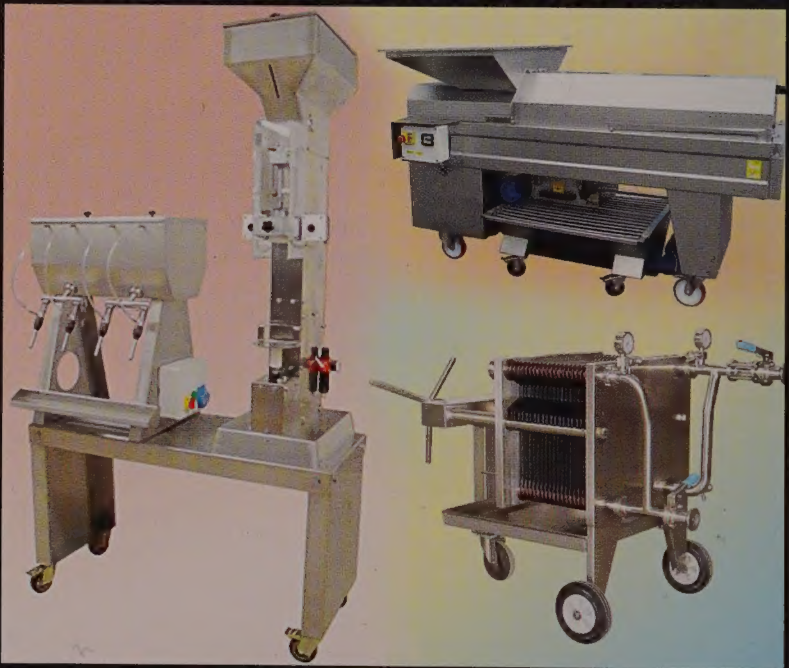
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However, it has been shown that elevated ethanol concentration could have a negative effect on the textural properties of wine. Ethanol increases the perception of bitterness in both white and red wines,[2,24] increases the perceived warmth or hotness of wine,[4,20] and can generate a mouthfeel that is drier, rougher, and more metallic in character.[4]

While higher total soluble solids at harvest will result in a wine with higher alcohol, everything else being equal, the equally important effects from other grape components also being enhanced or altered with higher ripeness cannot be ignored. Wines made from very ripe grapes can have a raisin-like or jammy character, and high-alcohol wines can be perceived as "heavy" or too highly flavored or even liqueur-like.

The balance between type and intensity of fruit flavor with the alcohol level is very important. One cannot assume that there is always a direct relationship between the actual alcohol level in many wines, and the apparent alcohol level perceived by consumers. The ***relative*** concentration of alcohol with other compounds is as important to wine quality as its ***absolute*** concentration.

Considering the large numbers of different wines available to consumers in the Australian market, it is logical that consumers will look to a range of sources of information to help them to make a decision about what wine to buy.

In recent studies by Larry Lockshin and Simone Mueller of the University of South Australia Wine Marketing Group and the AWRI's Sensory Group, the relative importance of various cues to consumers was investigated in an experiment conducted on-line. The experiment simulated closely the experience of selecting a wine from a retail shelf.[6]

While, as expected, the strongest effects on wine choice were factors such as price and brand, the alcohol concentration on the bottle label was also found to be of some influence, providing a relatively small but nonetheless significant positive cue for consumers. The lower concentrations of alcohol were less frequently

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selected compared to the higher concentrations, providing evidence that some consumers can see the alcohol concentration as a guide to wine quality or flavor. Two of three groups of consumers responded in this way, with the third group, comprising a higher proportion of females who were generally more brand-driven, not being influenced by the alcohol on the label.

Bearing in mind that bag-in-box wines are often lower in alcohol, and premium wines from regions such as the Barossa Valley or Heathcote will usually have a higher alcohol level, it is possible that many consumers will have learned to associate alcohol concentration as an indicator of quality. Influencing consumers to associate preferred wines with label information showing lower alcohol concentrations is one of the challenges for wine marketers.

The link between alcohol and consumer taste preference has been studied at the AWRI, and varies widely across consumer groups. In recent studies, winemaker preference did not relate to alcohol concentration,[5] while almost 40% of wine consumers in Australia and more than 50% of wine consumers in China were found to have lower preference scores for higher-alcohol wines when tasted blind, which related to the degree of hotness and bitterness. For other consumers tested, there was no relationship of preference and alcohol concentration.

Similar trends were found for Riesling and Chardonnay, where the preferences of a sizable proportion of consumers tested were correlated negatively with alcohol concentration. Hence it is important for wineries to consider market demands and preference segments when deciding on alcohol concentration in wine.

In a recent study by French researchers,[21] experienced wine consumers did not like reduced-alcohol wines, where the only difference among wines tested was the alcohol concentration that had been decreased by reverse osmosis treatment. In this study, the highest concentration of alcohol was 14.2% v/v in a Chardonnay, with the red wines studied being 13.4% and 12.7% alcohol before treatment. Less experienced consumers preferred the lower alcohol wines.

Anecdotal experience with reverse osmosis-treated Australian wines suggests a partial explanation for the results of the French study. Wines are typically made to show a good balance of acidity, tannins, etc. in relation to the alcohol content, but some people believe that partial dealcoholization can lead to imbalance, perhaps contributing to the experienced wine consumers' dislike of the reduced-alcohol wines. For example, wine acidity can become more pronounced as sweetness is reduced, due to partial removal of alcohol.

Taking control of alcohol concentration has become a priority for the wine sector worldwide. The wine sector is taking its responsibility seriously in seeking a balance between alcohol concentration and flavor. It continues to respond to demands from public health professionals and legislators; manage the intensifying push for higher taxes and duties that would increase production costs and prices paid by consumers; and meet the shifting preferences of consumers to lighter and lower-alcohol wine styles. These interconnected socio-economic, market imperatives, and issues of wine quality will drive research to develop and evaluate strategies to reduce alcohol in some wine styles.

The scope of this article does not include considerations of wine quality and wine style. Rather, the objectives are 1) provide grapegrowers and winemakers with practical information on a range of approaches that might be used to control alcohol concentration over the short- to medium-term; and 2) unveil emerging technologies aimed at keeping alcohol concentration in check.

Viticultural practices

REDUCING LEAF AREA – The rate of sugar accumulation in berries is largely determined by the ratio of leaf area to fruit weight (LA/FW). However, flavor and phenolic maturity may be independent of LA/FW. A relatively high LA/FW may cause sugar concentration to reach an unacceptably-high concentration when that flavor or phenolic maturity is judged to be optimal for a particular wine style.

In theory, it should be possible to delay sugar accumulation relative to other compositional changes during ripening so as to achieve wines of lower alcohol concentration without any untoward effects on flavor and structure. Therefore, a reduction of leaf area after fruitset may lead to better synchronization of sugar and flavor/phenolic ripening. This can be achieved by defoliation (leaf removal above the cluster zone) or

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by shoot-tipping (reduction of leaf number per shoot).

Although research on this topic to date is limited, some studies have reported success of these approaches. For Riesling in Germany, reducing LA/FW after flowering with either mechanical defoliation or shoot hedging by 28% and 57%, respectively, caused a delay in maturity by 14 to 20 days without any effect on titratable acidity(TA) and pH.[31]

John Whiting achieved a significant delay in sugar accumulation for Shiraz grapes when the leaf area was reduced by more than 50% at any time from the end of rapid shoot growth to veraison; yield was not affected but anthocyanin concentration was reduced.[34]

In many regions in Australia, these practices should be trialed with caution because they may cause excessively-delayed ripening at high crop loads, or could lead to excessive fruit exposure and therefore heat-damaged fruit.

PRE-HARVEST IRRIGATION – Anecdotally, increased irrigation during the last few weeks before harvest has been reported by some winemakers to cause a significant delay in ripening with concomitant reduction in wine quality. However, this is not necessarily supported by experimentation. When irrigation applied to Cabernet Sauvignon in a hot region of California was doubled for the period of ripening from 22° Brix to harvest, there was only a slight reduction in wine ethanol concentration in one out of two seasons (Carrie McDonnell Wood, personal communication). Furthermore, similar irrigation practices have shown no significant effect on wine sensory score or wine composition. [22,30]

SAMPLING TECHNIQUES – Most discrepancies between expected ethanol concentration in wine and the real concentration obtained, can be attributed to incorrect sampling and/or inaccuracy in the methods utilized. Vineyard sampling techniques must ensure that results obtained for total soluble solids (TSS) accurately represent the state of ripeness of the vineyard and that the method used to measure TSS produces accurate, reproducible results.

In order to evaluate the progressive change of grape maturity in the vineyard, grapes should be sampled at several intervals before ripeness, and TSS results should be plotted, enabling estimation of the desired harvesting date by extrapolation. Adequate planning will then ensure the vineyard is harvested at the correct time, such that a must with the desired (not higher than expected) TSS level is obtained.

Fermentation and winemaking practices

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tions can later be recombined in various proportions to achieve optimal wine quality.

Standard winemaking practices which ensure the efficacy of making wine additions necessitate the use of water to dissolve things such as tartaric acid or to convert bentonite into a usable slurry. These practices are regulated in most countries with the total amount of water not to exceed certain limits. In Australia, water added as part of permitted wine additions, such as fining agents, is limited to 7% v/v (70 mL of water per litre of wine).

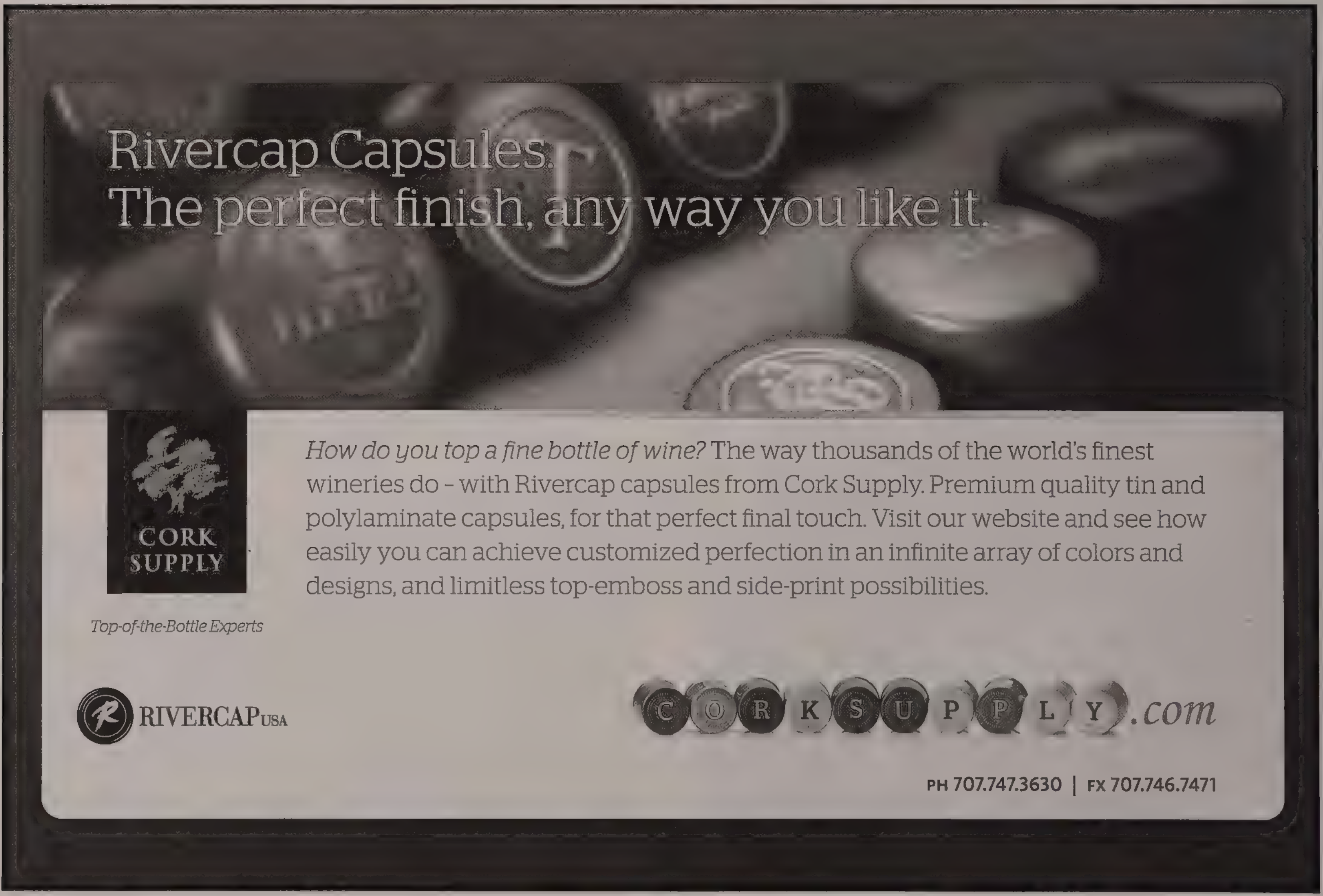
Winemakers normally seek to limit any dilution factor because it would obviously have the effect of diluting wine flavor. However, if the total permissible addition of 7% were made, it could potentially lower the final alcohol concentration by almost 1% v/v. It is of key importance that the effects of dilution on other must parameters (such as titratable acidity) and wine flavor be considered.

Enzyme additions – The enzyme glucose oxidase (GOX) from the fungus *Aspergillus niger* catalyses the conversion of glucose into gluconic acid and hydrogen peroxide. Addition of commercial preparations of enzyme GOX to grape juice before fermentation has been shown to decrease ethanol concentration in the resulting wine by 0.7% v/v compared to untreated wines.[9] Since GOX works more efficiently when oxygen is supplied, this figure could be improved by aeration of the must.

However, due to the gluconic acid produced, GOX activity causes an increase in total acidity and a slight decrease in pH which can affect wine balance. The addition of GOX also increases the number of carbonyl compounds that can bind sulfur dioxide, resulting in higher SO_2 demand.[29]

The effect of hydrogen peroxide production on wine color or phenolic compounds has not been investigated in detail, but higher values for browning (measure by A_{420} nm) for wines treated with GOX have been reported.[27] Increased oxidation of phenolic substrates has been suggested as possible hypotheses accounting for these observations. Sensory analysis of these wines has shown lower intensity of fruit aromas, reduced length of flavor, and high acidity compared to untreated wines.[28]

Fermentor design – There is some evidence that aeration and higher fermentation and cap temperatures can decrease alcohol concentration. Tank type and design have also been indicated as important factors, with open top fermentors reported to produce lower alcohol concentration after fermentation. The AWRI has received anecdotal reports that reductions of 1% v/v ethanol can be achieved by aeration. Similar reductions have been



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reported by fermenting in small, open-top tanks.[16] However, scientific studies have yet to establish the degree to which these factors modify alcohol concentration and wine flavor.

Choice of Wine Yeast – Generally, commercial wine yeasts do not show much variation in the amount of ethanol produced in wine following fermentation. AWRI studies using six commercial strains, Maurivin B, AWRI 796, AWRI R2, EC1118, UCD 522, and N96 which represent the entire range of ethanol yield in wine according to yeast manufacturers, showed a maximum difference in ethanol concentration of up to 0.5% v/v when fermenting the same Chardonnay juice.

Similar differences in final ethanol concentration for a wider range of wine yeasts (113 strains) fermenting synthetic grape juice have also been reported.[25]

Although there are no published data on final ethanol concentration in red varieties, our research indicates that 0.5% v/v is very likely the maximum difference possible by choosing a currently available, commercial wine yeast strain. The yeast strain AWRI 796 has been shown, in our laboratory-scale trials, to produce lower ethanol concentration than several other commercial wine strains.[5] For example, compared to EC1118, AWRI 796 delivered an ethanol reduction of ~0.4% v/v.

AWRI research has also shown a clear link between ethanol and glycerol concentrations with lower ethanol concentrations being associated with a higher glycerol level. For example, AWRI 796 produces greater glycerol concentration than other commercial wine yeasts. In addition, this yeast is able to complete fermentation of musts prepared from high Brix fruit, although attention to YAN (yeast assimilable nitrogen) and aeration are important in clarified musts. AWRI 796 also produces higher titratable acidity (TA) than others, typically due to increased production of succinic acid.[13]

Wine processing technologies

Ensure that application of the following methods complies with wine regulations of your destination market.

Physical Removal of Wine Alcohol – Processing options for reducing alcohol concentration in wine include membrane-based systems (such as reverse osmosis and evaporative perstraction), vacuum distillation, and spinning cone technology.[11,14,35] These techniques allow for effective and precise control of alcohol reduction, and are used by some wine producers around the globe. In some circumstances, however, these approaches can affect other aspects of wine quality.

For example, flavor compounds might also be removed with alcohol; lowering alcohol by 2% v/v using vacuum distillation has been found

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to reduce the concentration of higher alcohols by 25%, and esters by 45%.[1] Scientific literature studying the impact of these approaches on wine flavor is currently limited.

A pragmatic approach to minimize potential quality loss is to totally dealcoholize a small lot of wine, which is then back-blended to achieve the desired overall alcohol concentration. Before implementing any of these alcohol control measures, it is critical to ensure that their application complies with relevant wine regulations for the destination market.

Loss of alcohol by evaporation – During oak maturation, both water and ethanol evaporate through the barrel. The driving force for this diffusion of water and ethanol is the difference in their concentrations between the wine in the barrel and the surrounding air. The greater the concentration difference, the faster the diffusion rate. Hence, ethanol concentration slowly increases in dry cellars as water diffuses, and then evaporates faster than ethanol in this environment.

Conversely, in cellars with a relative humidity above 70%, ethanol concentration slowly decreases over time.[10] Alcohol was reported to drop by 0.2% v/v when barrels were stored for 12 months at 15°C with relative humidity above 90%. Mold development is a risk when barrels are exposed to high humidity for prolonged periods, and so appropriate monitoring and control strategies should be implemented.

Conclusion

Relatively high concentrations of alcohol in wine are increasingly becoming a challenge for the wine sector and consumers. In response to this, many grapegrowers and winemakers are exploring approaches to reducing ethanol content in wine without compromising quality.

At this time, there is no single approach that can be applied across the industry to achieve an ideal outcome, but there are many options available to reduce ethanol concentration, and most of these are compatible with each other and therefore can be used in combination.

Some of the options described in this article achieve greater reductions in alcohol content than others but, in all cases, it is essential to pay attention to any sensory and other quality changes associated with the approach used. However, it is important to remember that, whatever practices are adopted, they must comply with regulations, both local and associated with destination markets. ■

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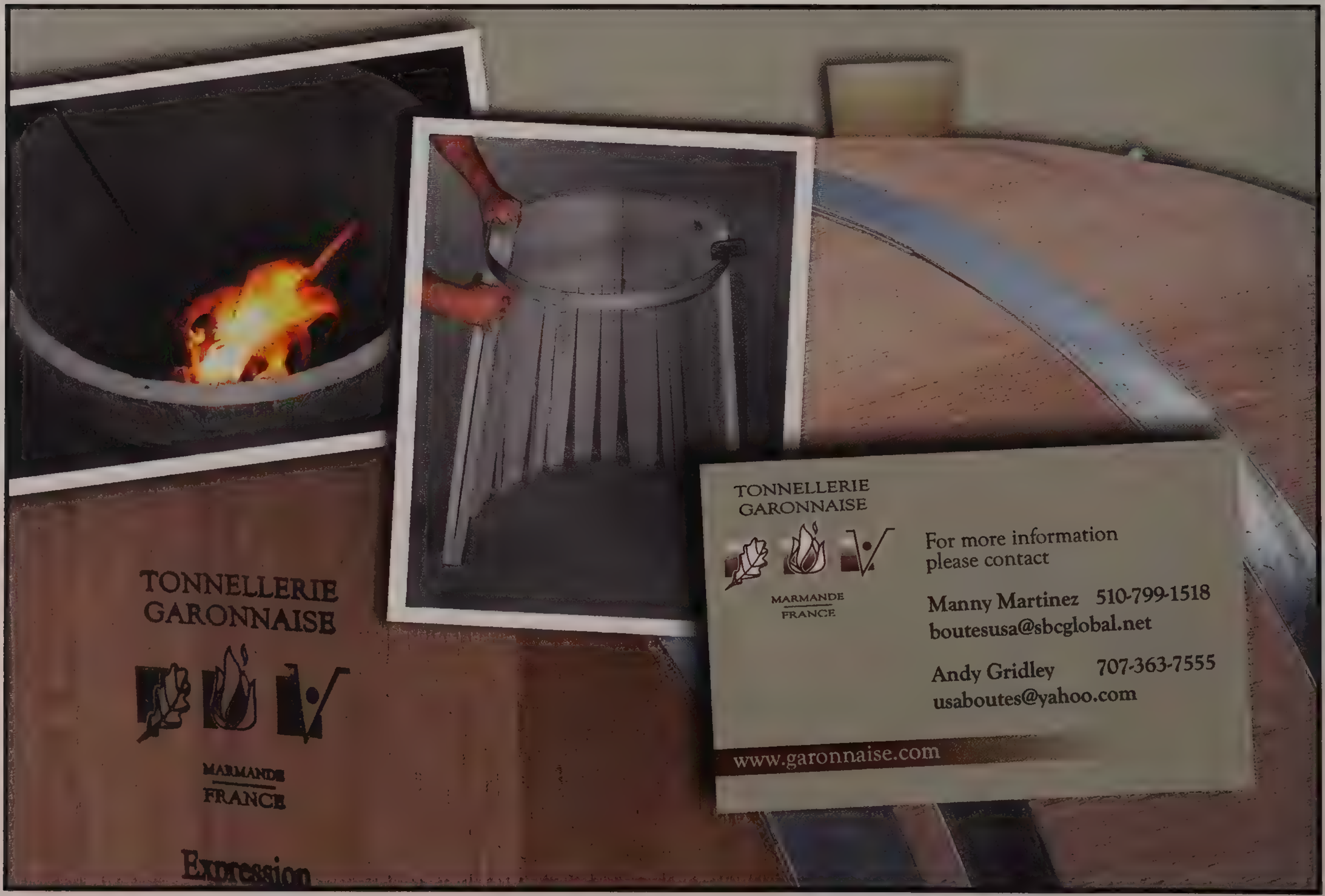
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paper is based on experience and review of current scientific data and was gathered from the collective expertise of practical grapegrowers, viticulturists, winemakers, and scientists at the AWRI. Rae Blair is thanked for her editorial assistance.

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SOIL MAPPING TECHNOLOGY

Identifying reserve-quality soils in vineyards

BY Bryan Rahn, CP Ag/SS, CCA,
Coastal Viticultural Consultants. Inc.
Angwin, CA

Grape growers want to achieve several basic objectives. We want to maintain our vineyard's health and productivity. We also want to be good stewards of the land and conserve resources. Most of us are proud of the grapes we deliver to wineries and want the fruit quality to meet everyone's expectations, especially our own.

As a consulting soil scientist and viticulturist for more than 20 years, I have helped many growers and wineries achieve those goals. Uniformity of growth and fruit maturity within each vineyard block or sub-block is one of the keys to those successes. A common limitation in many vineyards is excessive variability within the vineyard blocks.

A uniform vineyard block or sub-block is much easier to manage and allows growers to direct valuable inputs only where they are needed. If the vast majority of the fruit is of similar physiological maturity then selecting a harvest date is easier and the wine is potentially improved. The major factor responsible for

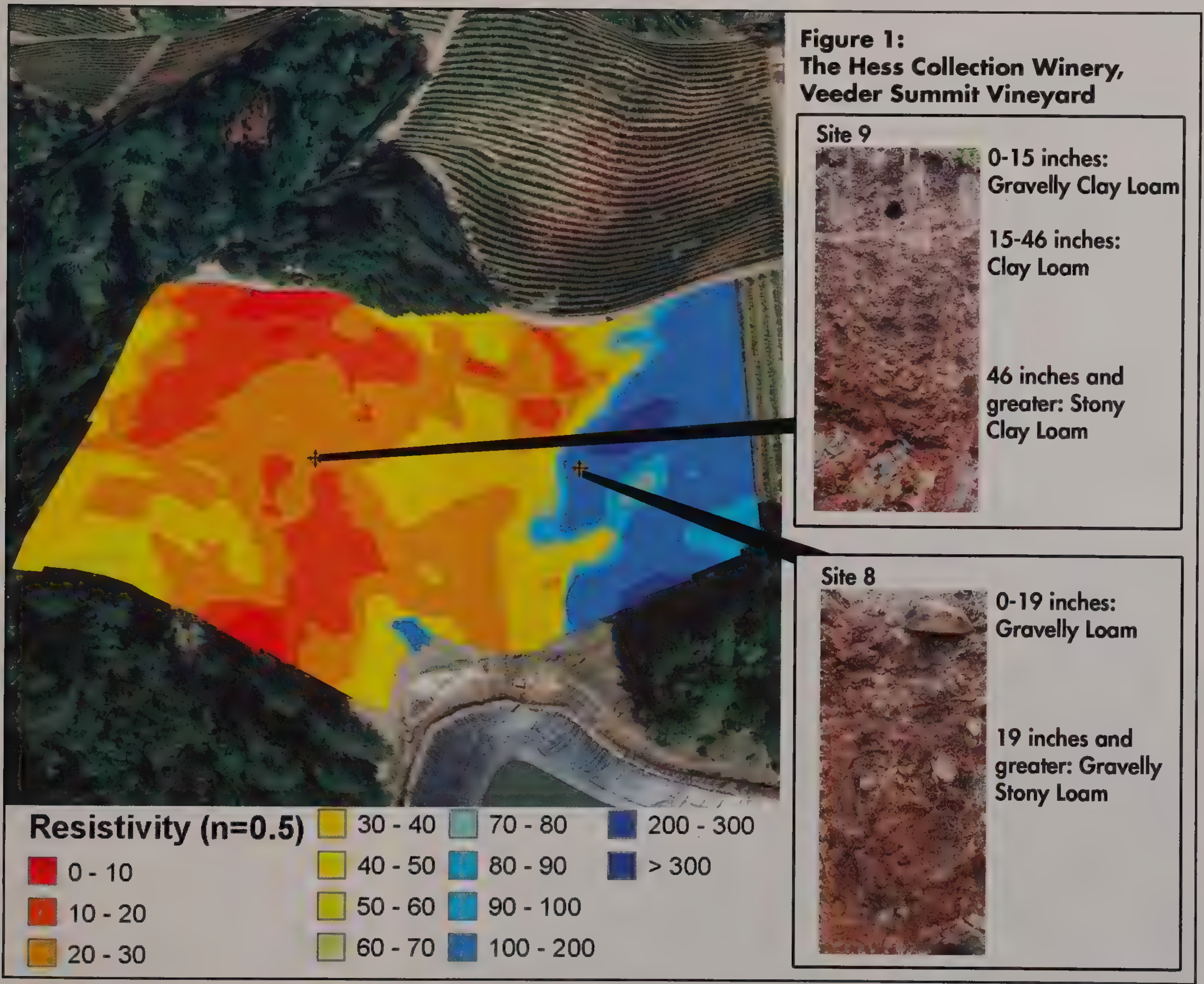
Figure 1:
The Hess Collection Winery, Veeder Summit Vineyard

variability in growth and ripeness in most vineyards is the soil.

It is important to know your vineyard's soils and group them into units with similar characteristics. Successfully irrigating, fertilizing, or harvesting a vineyard block with very different soil characteristics is difficult. Fruit quality will usually suffer. Over-irrigating deep soils while under-irrigating rocky soil areas is a typical scenario. Trying to farm somewhere in the middle or averaging the two distinctly different soils reduces fruit quality in both areas.

One of my mentors told me years ago: if you put one foot in boiling water and the other foot in ice water then on average you should feel fine. In other words, "using averages" sometimes does not work.

Evaluation and mapping of soils

There are several methods to physically evaluate and map soils. Soil augers or probes can be used to collect soil samples. My preference is using a backhoe or mini-excavator to expose soil profiles for physical evaluation and sampling. This, in my opinion, is the best method to thoroughly evaluate soil profiles to the potential depth of rooting (sometimes six feet or more).

Once you have selected the tools, the next question is where do you dig? National Resource Conservation Service web-based soil maps are a good place to start (www.websoilsurvey.nrcs.usda.gov). The maps are a great resource; however, not usually sufficient to design a vineyard.

If your vineyard contains very different soils then where are the boundary limits of each soil type? Accurately delineating soil type boundaries can be challenging.

An experienced soil scientist can use topography, vegetation, surface soil color, and other clues to help delineate soil boundaries. Another approach is to layout a grid across the study area and dig a pit at each point where the grid lines intersect. The grid method is more labor-intensive. Both of those methods do work, however, there is a better way.

"Non-invasive" soil mapping technologies, when properly employed, can accurately delineate soil changes. One of my initial concerns in using these technologies in vineyards is possible interference from metal stakes, trellis wires, and end posts. The potential for interference depends upon the technology used, sounding depth (the depth of measurement below surface grade), and width of the tractor row. The likelihood of interference from metal wire and trellis increases as tractor-row width decreases.

For example, there is research (Lamb, D.W., A. Mitchell, and G. Hyde. 2005 "Vineyard trellising comprising metal posts distorts data from EM soil surveys." *Australian J. of Grape & Wine Research* 11: 24-32.) that indicates that electromagnetic technologies are prone to significant interference issues in existing vineyards with a tractor row that is 3 meters (+/-10 feet) wide or less. This can be a serious limitation when soil mapping in existing vineyards.

However, other non-invasive technologies can be successfully employed in vineyards with an all metal trellis system. My intent here is not to compare these technologies or select one method as the "best." This article is intended to report how Coastal Viticultural Consultants (CVC) successfully employs non-invasive technology in soil mapping projects.

First a few basics: CVC uses an instrument that measures apparent soil resistivity at two (or more) depths below surface grade. Soil resistivity is a measure of the soil's resistance to carrying an electrical current. Resistivity is the inverse of conductance; the ability to carry an electrical current.

The equipment used in the mapping consists of a GPS receiver, data logger, and a towed array of sensors. An ATV tows the sensors back and

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forth in a pattern of lines across the study area. Approximately 1,000 geo-referenced data points per acre are collected and processed to produce soil resistivity maps.

A geo-referenced soil resistivity map accurately delineates soil changes in the study area. Sample locations are improved using these maps. "Directed sample" soil evaluations are an improvement over less precise sample site selection methods (topography, vegetation, surface soil color, etc.) and less costly and less labor-intensive than grid pattern soil evaluations.

The collected GPS data, light detection and ranging or other data sources can be used to create a Digital Terrain Model (DTM) that is a three-dimensional map of the study area. CVC uses Digital Terrain Models to determine topographic derivatives (slope, aspect, surface curvature) for use in soil mapping, vineyard design, and delineating management units within existing vineyards. Presenting the soil resistivity data in a three dimensional format enhances visualization of the soil units in relation to topography. Examples of DTM soil resistivity maps are Figures 1 and 2.

Soil texture, percent of rock or gravel, and moisture content have the greatest impact upon apparent soil resistivity readings in most vineyard soils. However, total salt concentrations and other soil characteristics can also impact soil resistivity.

CVC identified a resistivity measuring technology where the sounding depth can be adjusted. This is an important feature because adjustments to the sounding depth can be used to help eliminate interference from stakes, wire, and end posts. Changing the distance between the receivers and transmitter varies the sounding depth (depth of measurements).

Using variable sounding depth resistivity technology, CVC has successfully mapped soils in existing, metal-trellised vineyards with tractor rows as narrow as six feet. However, experience with the instrumentation is required to properly set up the equipment and interpret soil resistivity maps, as is true with other similar technologies.

TWO CASE STUDIES

The Hess Collection

The Hess Collection Winery (Napa, CA) retained CVC in 2009 to map 65 acres of soils in vineyards slated for redevelopment on Mount Veeder in Napa County. The Hess Collection Winery produces premium estate Cabernet Sauvignon and Chardonnay.

The Plan:

The first step was to map the soils using soil resistivity technology. Two soil depths were mapped for apparent resistivity: one-meter and two-meters. The system geometry was set up for the appropriate sounding depths and the instruments were dragged at set intervals on the soil surface throughout the vineyard. Resistivity data was collected twice every second and recorded with GPS data in the data logger.

Soil Resistivity maps:

The recorded data was filtered and processed using two software programs. The result is a geo-referenced soil resistivity map (Figure 1) that identifies and locates soil variability within the study area. If you work with enough resistivity maps then you can begin to infer some things about the soil properties by using the resistivity data.

In general, the lowest soil resistivity readings reflect clay loam or clay-textured soils and/or wetter soil conditions. The more moderate readings typically represent loam-textured soils. The highest readings (most resistive) are usually sandier or rocky soil conditions.

Soil resistivity will also delineate soils derived from different parent materials (sandstone, shale, meta-

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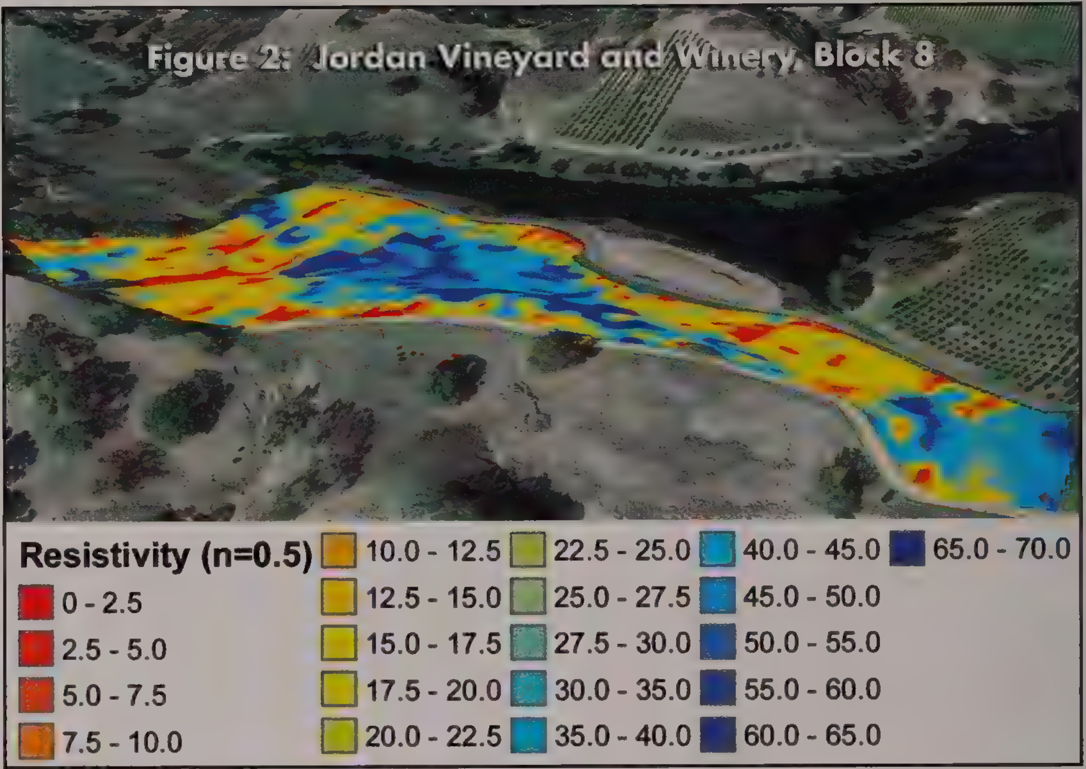
Figure 2: Jordan Vineyard and Winery, Block 8

Block Lake 8 soil resistivity with topography data.

Corresponding view of Jordan Block Lake 8.

morphic rock, etc.). Parent materials are the materials that, through weathering, provide the basic components that form soils. The parent material of the soil can have a profound impact on vineyard performance and the flavors imparted to the fruit and wine.

Soil resistivity maps do not thoroughly evaluate soil properties. The maps show where the variability is located. The next step is to evaluate the different soil groups identified in the soil resistivity maps. It is important to always ground-truth any soil map produced with non-invasive technology. Finally, an interpretation of the soil characteristics is needed to design a vineyard or formulate a management plan using soil map data.

A mini-excavator was used to expose the soil profiles in each soil unit for evaluation. A thorough soil evaluation was performed by a certified professional Soil Scientist from CVC to quantify each mapped soil unit. Soil profiles were described using standard methods of soil classification employed by the Natural

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Resource Conservation Service (NRCS) and soil samples were collected from the strata observed for laboratory analysis.

Individual soil units should be evaluated for chemistry, soil physical factors, available water holding capacity, soil pests, and other pertinent information. Soils, geology, water quality, and climate are all important components of a vineyard study.

The soil data was then evaluated by CVC and used to formulate soil amendment and fertilizer inputs, vine and tractor-row spacing, row direction, irrigation sets, rootstock selections, and sub-blocks.

CVC presented this information in geo-referenced soil chemistry and vineyard block maps. For example, two very different soil units were identified and located in Block 3, Soil Study Sites 8 and 9 (Figure 1). The rockier soil area (Site 8) can now be accurately separated from the deeper, less rocky soils at Site 9. The soils mapped in this block require separate irrigation sets, different soil amendments, and different rootstocks to optimize wine quality. New vineyard development will be designed and installed to best match existing soil conditions.

Available waterholding capacity (AWC), soil chemistry, soil physical conditions and nematode presence impact the vigor capability of vineyard soils. Rootstock selection was based upon the soil vigor capability ratings, vineyard spacing, and irrigation water availability. The rootstocks that best matched the existing soils were primarily 420A and 3309C. Some Riparia, 101-14, and 1616C rootstock was also planted.

Sander Scheer (Hess Collection viticulturist), worked with CVC personnel in the design phase of the redeveloped vineyards. Scheer reports, "Soil resistivity has given me a great starting point to work from when laying out new vineyards. We can make a plan for backhoe pit locations prior to heading out into the field based on the variability identified in the resistivity mapping. This technology allows us to consistently find where one soil type ends and another begins. Knowing with confidence where soil breaks occur has allowed us to address each soil unit separately. Uniformity within each vineyard sub-block has lead to more balanced vineyards and increased fruit quality, no question."

Jordan Vineyard and Winery

Jordan Vineyard and Winery (Healdsburg, CA), retained CVC to map soils in 100 acres of existing vineyards (ten blocks). Jordan Winery produces premium Cabernet Sauvignon and Chardonnay. The vineyards are primarily hillside Cabernet Sauvignon with a 5x9 vine and row spacing trained on a VSP trellis.

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BACKGROUND:

In the late 1970s and through the 1980s, Rob Davis (Jordan Winery's winemaker for 35 years), traveled extensively with Andre Tchelistcheff (renowned winemaking consultant) in Europe, particularly France and Italy. During these many journeys Davis experienced the influence soil had on wine flavors. Eventually Davis was convinced that he could identify the soil type by tasting wines. At that time the idea of soil impacting wine flavor was not readily accepted in the U.S.

Davis believes a "reserve (Grand Cru) quality" area must have two things: the proper soil and climate. Davis knows vineyard management techniques (husbandry) can impact wine quality greatly and is required to produce a reserve quality wine. However, Davis also believes without the soil and climate, husbandry alone can only achieve so much in the wine.

He questioned the wisdom of making major inputs into vineyard blocks that are not likely to make the quality grade for Jordan's wine program.

Davis knew that there were certain soils that would give Jordan Winery wines the characteristics that they desired. "When I taste wines, I go straight to the soil type," says Davis. "I can identify certain characteristics in wines derived from soils."

THE PLAN:

Soil mapping was used to identify "Reserve" potential within the hillside vineyards at Jordan Winery. CVC would map each vineyard block with a soil resistivity system in order to efficiently locate soil variability within each block. Each block was mapped at two depths, one meter and two meters below surface grade. Each of the soil units (25 sub-blocks [smallest acreage = 0.6]) identified in each block was evaluated by a Certified Professional Soil Scientist from CVC.

Fertility and irrigation strategies were recommended by CVC for each soil unit using the soil analysis, soil profile information, and resistivity mapping.

A rating system was applied by CVC to each soil zone according to its potential to reach "Reserve" status. The criteria used to rate soils included geologic parent materials, available water-holding capacity, cation balance, soil physical factors (soil texture, depth, compaction, etc.), fertility status, and organic matter content.

Each soil unit sub-block was marked in the field with flagging tape. Brent Young, Jordan Winery's viticulturist, uploaded CVC's georeferenced soil resistivity maps into their GPS unit to locate the appropriate areas for flagging within each vineyard block.

Brent Young and Dana Grande used the soil resistivity maps and field flagging to direct inputs and cultural practices per the management plan for each sub-block. Fertilizer inputs included varying amounts nitrogen, calcium, and potassium applied through the drip system. Minor elements (zinc, boron) were applied with foliar sprays.

Irrigation strategies were fine-tuned by sub-block according to accurate, volumetric soil moisture measurements (neutron probe) and plant mapping data (shoot growth, phenological stages, stress index, etc.) collected by CVC during the growing season.

Composite fruit samples were collected in 2009 using the sub-block maps. Composite fruit samples were crushed and Jordan Winery's winemaker, Rob Davis and assistant winemakers Maggie Kruse and Ronald Du Preez made sensory evaluations

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of the juice samples as the fruit ripened to evaluate the quality and potential of each sub-block.

RESULTS:

Each sub-block received the treatments per the custom farming plan. The "Reserve Wine Potential" rating system and soil mapping was verified with the winemakers' palates as they tasted composite juice samples from various sub-blocks.

Each of the sub-blocks were harvested and fermented separately. The resulting wines confirmed that the custom, sub-block farming plan employed by Jordan Winery is yielding results.

"The fruit in Block 8 (12-acre Merlot vineyard) is the best it has ever been," says Davis. "This technology is definitely better than using aerial imagery (to design custom vineyard plans). Our sensory evaluations correlated strongly to soil types. The application of this technology is fantastic."

Jordan's viticulture staff also has a better understanding of the soils effect on wine flavors. Brent Young described this soil maping technology "as a window to see into the soil." Jordan Winery can now manage each area according to its' potential to produce wine with desired characteristics. Resources can be applied more efficiently and identification of areas where a more likely return from inputs is now possible.

Summary

Non-invasive soil technologies can be successfully employed to both improve the design of new vineyards and management of existing vineyards. Separating the soil units in your vineyard can improve sub-block vineyard uniformity, efficiency of vineyard inputs, help better manage your vineyard and identify reserve wine potential in your vineyards. ■

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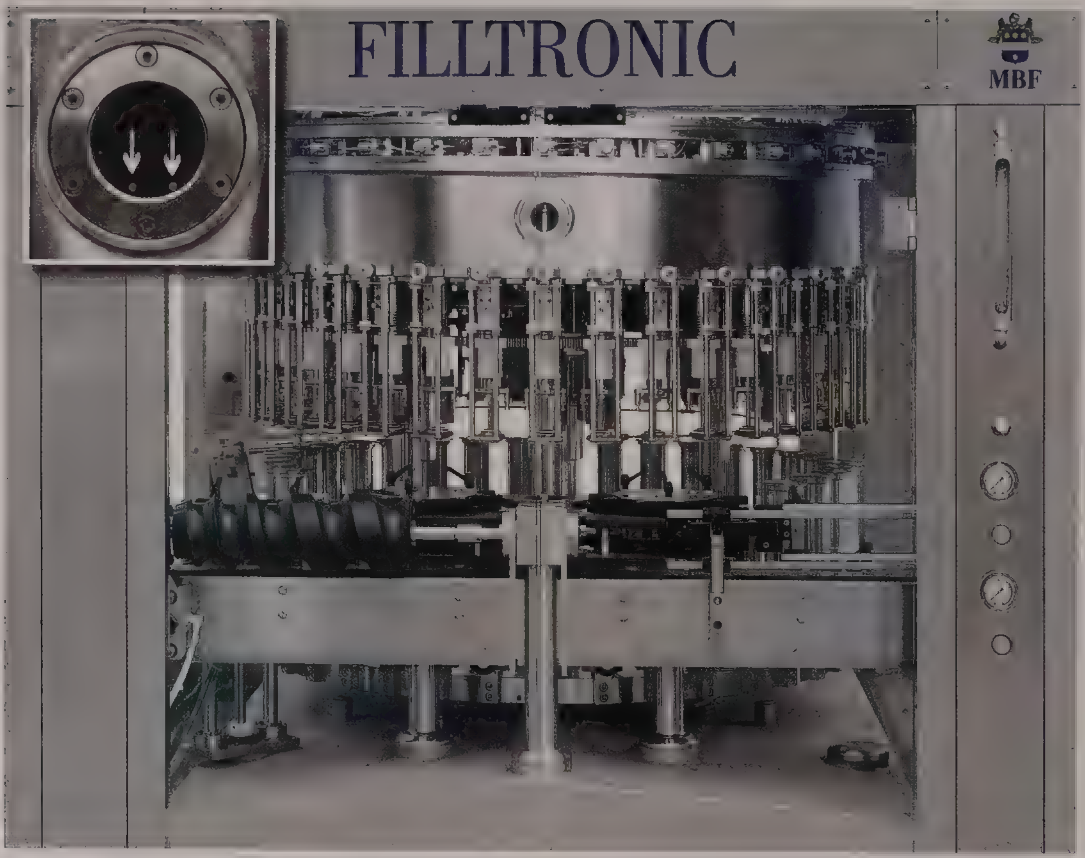

ACCURATE OXYGEN MANAGEMENT IN WINE BOTTLING

**BY Roberto Ferrarini, DiSTeMeV,
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Management of oxygen is one of the most critical factors for wine quality. Notably, it is the bottling phase that can compromise all the work to obtain a quality wine, due to an excessive or uncontrolled introduction of oxygen.

This study determined optimal conditions to provide an appropriate inertization (protecting wine from oxidation) of different types of bottles by varying the sparging parameters. A method of measurement was developed that can be applicable on all bottle filling machines where monitoring of oxygen pickup is desired.

The variables that can influence the oxygen content in this phase of the process have been identified and evaluated: inertization with inert gas before filling, and set-up of the filling machine for bottling with different bottles. The data have been processed, determining the best filling conditions and correct setup in order to obtain an oxygen increase of less than 0.2 ppm.

Modern winemaking includes strategies, technologies, and processes to be used beginning with harvesting, up to the last production phase of bottling, with the aim to produce a quality wine.

The attention of winemakers in the last phases of production includes assuring stability and shelf-life of wine by filtration, addition of enological adjuvants, and protection from oxidation. But often the interventions are mainly focused on the wine, giving low importance to the oxygen pickup during bottling, which is deemed to be out of their control, and ultimately the responsibility of the machinery manufacturer.

The actual performances of bottle filling machines is usually not very well understood, the settings are random and empirical, and quite often based on the experience of winemakers and bottling line managers.

**FIGURE 1 (LEFT): MBF Filltronic low vaccum filler used to perform tests.
FIGURE 2 (INSET IMAGE): Two Presens measuring PsT3 sensor dots glued on the specola of the filler bowl.**

To evaluate a filling machine's performance regarding oxygen intake, a measurement method has been developed that can be applied on different bottle filling machines.

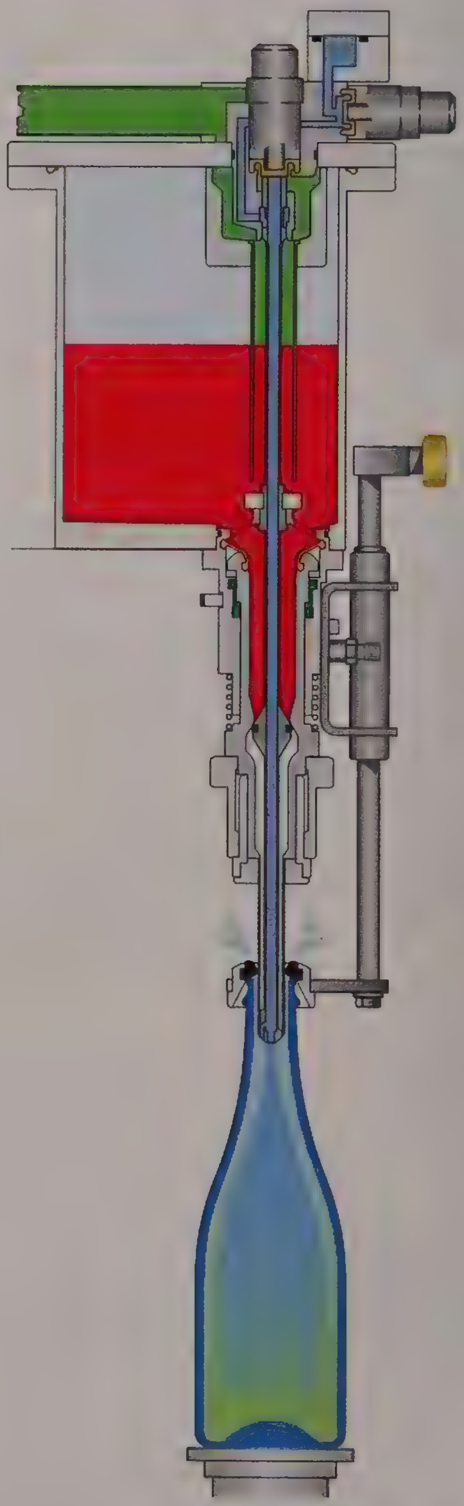

FIGURE 4: Inertization phase of the tested bottle filler with inert gas (blue), oxygen-rich atmosphere (green), and wine in filler bowl (red).

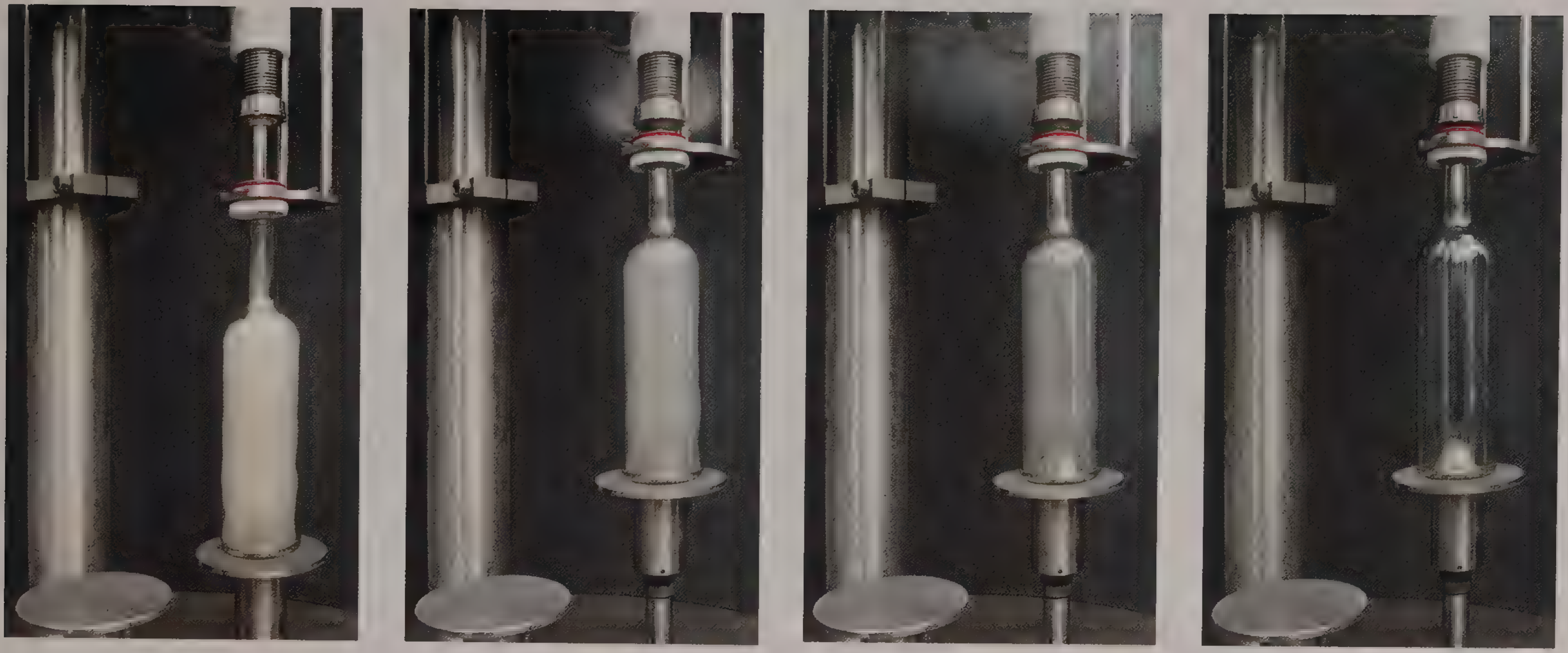

Illustration of inertization with gas from the filling valve; a bottle filled with smoke is delivered into the filling machine. The pedestal partially raises the bottle to the valve and inert gas is introduced to expell the smoke outside of the filling machine. The bottle is then fully elevated onto the valve, forming a seal to begin filling of wine. This all occurs in approximately 1.5 seconds (standard time in the text).

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The inertization needed in bottling can vary depending on the type of wine. Reductive white wines usually require more protection from oxidation than do full-bodied red wines, where some amount of oxygen could be accepted or desired.

The inertization volume of the bottle atmosphere depends both on the kind of filler used, and the adopted settings (pressure of inert gas, time and level of the blowing valve into the bottle). These have to be adapted to the different bottles, as the air substitution rate varies with bottle shape.

In order to reduce the cost and carbon footprint, it is important to manage the filler settings to give the best inertization results, with minimal nitrogen consumption, without a decrease in productivity.

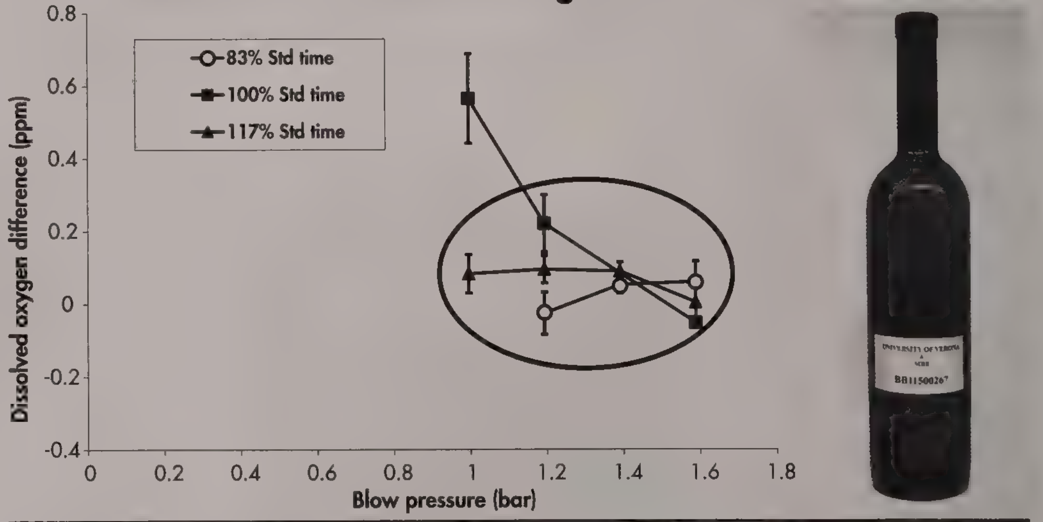
Material and methods

To measure oxygen intake during filling, a protocol has been developed that can be adopted on different kinds of filling machines. The measurements have been made on de-gassed water, where oxygen has been stripped down to 500 ppb, by blowing in nitrogen.

Tests were performed with an MBF Filltronic (MBF s.p.a., Veronella Verona, Italy), a low vacuum filler equipped with MBF filling valves for nitrogen injection (sparging) prior to filling, separate air return exhausting the bottle gas outside the filler bowl, and a nitrogen blanket within the bowl (Figure 1).

To obtain real nitrogen consumption, the flow (NL) was measured with a flow meter at different blowing pressures to calculate nitrogen used for each bottle at different durations

FIGURE 6: Test results for long-neck Bordeaux bottle

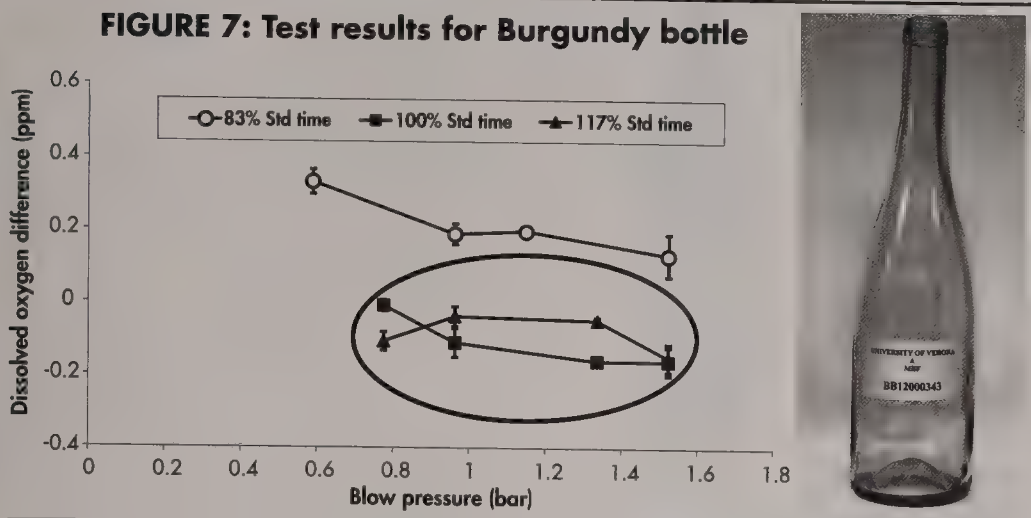


NITROGEN BLOW PRESSURE (BARS)	NITROGEN BLOW TIME	OXYGEN PICK-UP (PPM)	RELATIVE NITROGEN USE
1.2	83% standard	-0.035	0.771
1.4	83% standard	0.045	0.865
1.6	83% standard	0.052	0.959
1	standard	0.565	**0.718**
1.2	standard	0.216	0.812
1.6	standard	-0.062	1.000
1	117% standard	0.075	0.760
1.2	117% standard	0.088	0.854
1.4	117% standard	0.083	0.948
1.6	117% standard	-0.005	1.041

Best inertization settings considering nitrogen consumption.

Best setup combinations in order to achieve D.O. increases lower than .150 ppm, considering both nitrogen consumption and blowing time.

FIGURE 7: Test results for Burgundy bottle



NITROGEN BLOW PRESSURE (BARS)	NITROGEN BLOW TIME	OXYGEN PICK-UP (PPM)	RELATIVE NITROGEN USE
0.6	83% standard	0.270	**0.489**
1	83% standard	0.141	**0.677**
1.2	83% standard	0.149	0.771
1.6	83% standard	0.090	0.959
0.8	standard	-0.038	**0.624**
1	standard	-0.130	**0.718**
1.4	standard	-0.175	0.906
1.6	standard	-0.175	1.000
0.8	117% standard	-0.127	**0.666**
1	117% standard	-0.065	0.760
1.4	117% standard	-0.074	0.948
1.6	117% standard	-0.166	1.041

Best inertization settings considering nitrogen consumption.

Best setup combinations in order to achieve D.O. increases lower than .150 ppm, considering both nitrogen consumption and blowing time.

of the injection. Time and blow pressure settings were chosen considering productive conditions such as minimum productivity per hour, and avoiding excessive blowing pressures that can cause process inefficiencies.

Base parameters were the standard settings (initial values of gas pressure and duration of blowing) recommended for the filler. The time (duration) of the gas injection was then changed to 83% of initial value and, considering the results obtained, to 117% of initial time.

Bottles were filled using the normal cycle of the filler, which consists of inertization (injection) phase (Figure 4), where nitrogen is blown into the bottle at set pressure and time; the filling phase; and the leveling phase.

Dissolved oxygen (D.O.) measurements were made with a Fibox 3 LCD trace (PreSens Precision Sensing GmbH) oxygen meter with Pst3 sensors (Sensing Spot) applied on the inside of the specola of the filler bowl (Figure 2). In-bottle measurements were made using a device that extracts a sample of water from the bottle, displacing it with nitrogen, through a small pipe with a Sensing Spot attached (Figure 3).

D.O. was measured in the filler bowl before filling, and in the bottle

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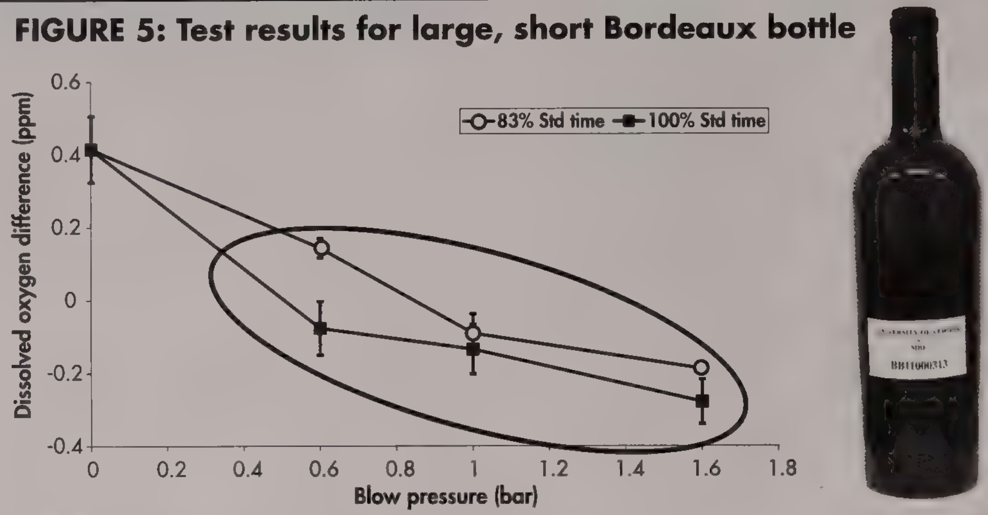
FIGURE 5: Test results for large, short Bordeaux bottle



NITROGEN BLOW PRESSURE (BARS)	NITROGEN BLOW TIME	OXYGEN PICK-UP (PPM)	RELATIVE NITROGEN USE
0	0	0.415	**0.000**
0.6	standard	-0.079	**0.531**
1	standard	-0.137	**0.718**
1.6	standard	-0.281	1.000
0.6	83% standard	0.142	**0.489**
1	83% standard	-0.093	**0.677**
1.6	83% standard	-0.190	0.959

Best inertization settings considering nitrogen consumption.

Best setup combinations in order to achieve D.O. increases lower than .150 ppm, considering both nitrogen consumption and blowing time.

after filling. Oxygen pickup was the calculated difference between the two D.O. measurements. From at least 10 measurements for each condition, average value and standard deviation were calculated.

The graphs in Figures 5, 6, 7, 8, 9 show D.O. increasing or decreasing on the Y axis. The nitrogen blow pressure is on the X axis. The different data series represent different blow times.

In the charts (see Figures 5, 6, 7, 8, 9), inertization settings which take D.O. pickup lower than 0.150 ppm are rounded and, in the tables, the best settings considering nitrogen consumption are in **bold**. Shaded rows show the best setup combinations in order to achieve D.O. increases lower than 0.150 ppm, considering both nitrogen consumption and blowing time.

Conclusions

Bottle inertization before filling highly impacts the final D.O. content in a wine. The use of different filling methods (bottom filling, counter pressure, low vacuum-gravity, etc.). can make the process less dependent on the inertization phase, but it still remains important in

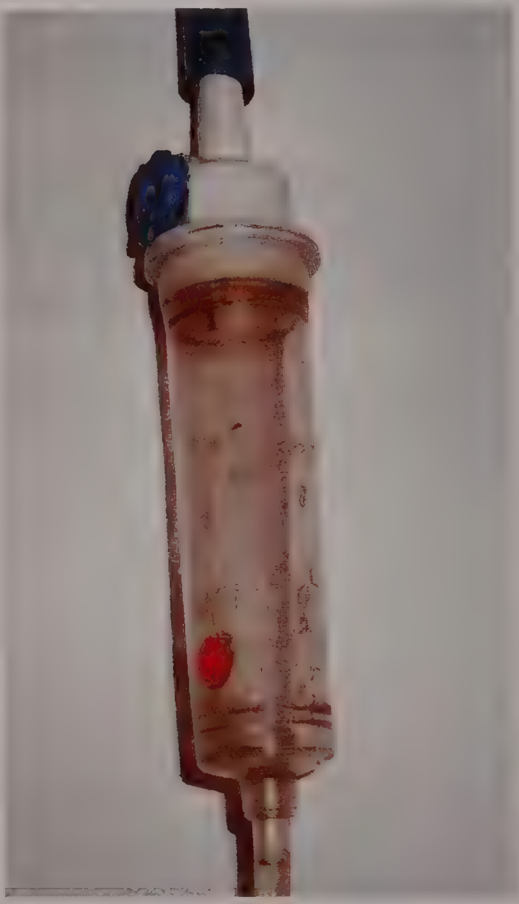


FIGURE 3: The device created for inline measurement of dissolved oxygen in the bottle.

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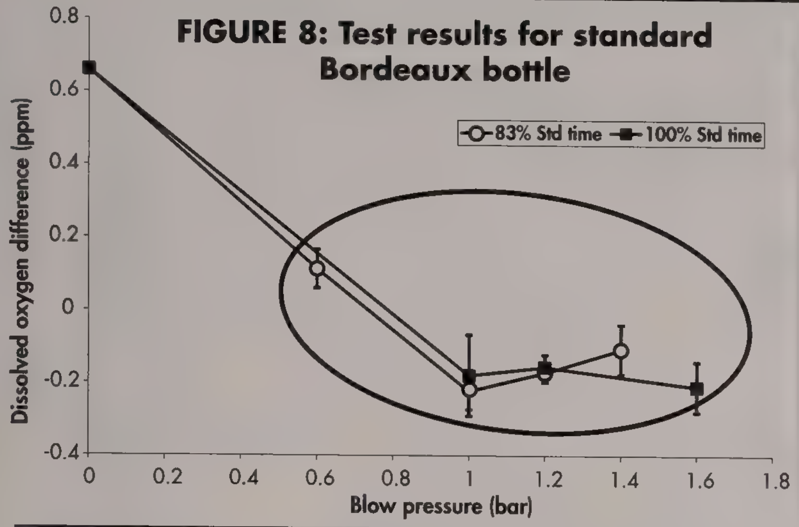

FIGURE 8: Test results for standard Bordeaux bottle

NITROGEN BLOW PRESSURE (BARS)	NITROGEN BLOW TIME	OXYGEN PICK-UP (PPM)	RELATIVE NITROGEN USE
0	0	0.660	**0.000**
0.6	83% standard	0.113	**0.489**
1	83% standard	-0.223	0.677
1.2	83% standard	-0.171	0.771
1.4	83% standard	-0.107	0.865
1	standard	-0.179	**0.718**
1.2	standard	-0.156	0.812
1.6	standard	-0.210	1.000

Best inertization settings considering nitrogen consumption.

Best setup combinations in order to achieve D.O. increases lower than .150 ppm, considering both nitrogen consumption and blowing time.

bottling lines since the wine, during filling, contacts a modified, controlled atmosphere in the bottle.

The degree of inertization differs with the machine settings and bottle type as shown by the chart data. In some cases, with a high level of inert gas atmosphere, wine D.O. can decrease during filling – most probably this is due to de-gassing of oxygen which occurs during filling in the inert gas atmosphere.

Short and large bottles favor inertization and lower D.O., especially considering the bottle neck dimensions. This is easily noticeable when looking at different results in Figures 5 and 7 using the same inertization process.

In some cases, it is more effective to increase the blowing time instead of pressure, because the shape of some bottles does not allow the air to flow out freely. This can be observed in Figure 7, where D.O. concentration is not dramatically affected by the blowing pressure, but mainly by the blowing time.

It is interesting to note that the Alsace bottle, usually used for reductive-style wines needing the most oxygen protection, is among the most difficult bottles to inertize. Particular attention is needed in the selection of inertization parameters.

It is necessary to know how the different parameters can effect filler performance, and to consider the bottle type, in order to find the best settings to apply in wine bottling.

Looking at and understanding the presented data, can help to make responsible decisions regarding the protection of each individual wine and bottle combination, and to understand the effect such decisions can have on the environment and wine production costs. ■

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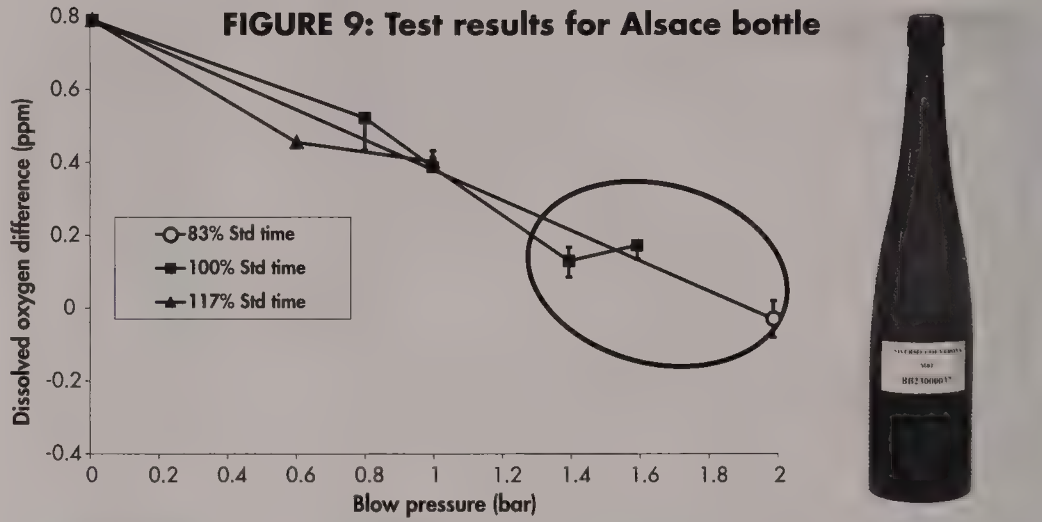

NITROGEN BLOW PRESSURE (BARS)	NITROGEN BLOW TIME	OXYGEN PICK-UP (PPM)	RELATIVE NITROGEN USE
0	0	0.740	**0.000**
2	83% standard	-0.150	1.146
0.8	standard	0.449	**0.624**
1	standard	0.303	**0.718**
1.4	standard	0.023	0.906
1.6	standard	0.070	1.000
0.6	117% standard	0.376	**0.572**
1	117% standard	0.319	0.760

Best inertization settings considering nitrogen consumption.

Best setup combinations in order to achieve D.O. increases lower than .150 ppm, considering both nitrogen consumption and blowing time.

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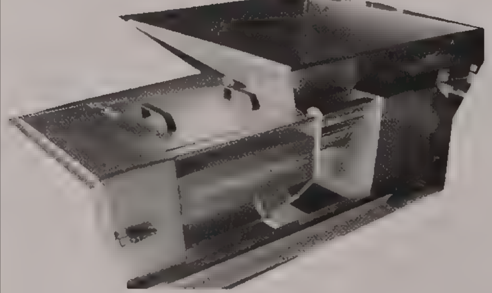

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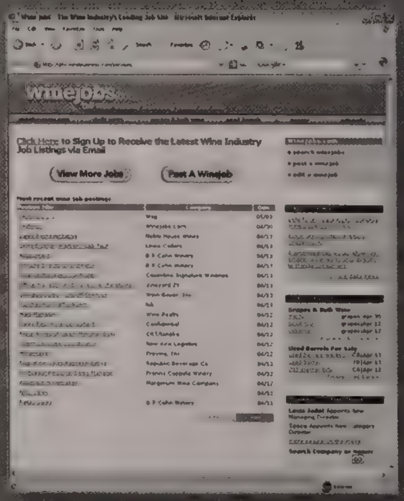

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Department of Technical Services,
Cork Supply, Benicia, CA

Until the early 1980s, natural cork was basically the only material used by the wine industry to close a bottle of wine. Cork was the only choice because it was considered the perfect material, unchallenged by centuries of winemaking practice. Then in 1981 and 1982, Swiss scientist Hans Tanner and his team published research that made the landmark association between 2,4,6-trichloroanisole (TCA) and cork taint.[1,2]

Winemakers have always been well aware of cork taint, but the problem was considered a very minor annoyance due to its very low rate of incidence. However, anecdotal accounts have reported that, since the end of World War II, the rate of taint climbed close to double-digit figures, particularly during the 1970s and 1980s.

This situation, understandably, created much angst among winemakers, while at the same time leading to an epic struggle to find a satisfactory means of wine packaging. During the ensuing years, innovative and entrepreneurial individuals worked hard to develop reliable and consistent wine closures that kept precious wine vintages away from oxygen with no negative effects.

At the same time, commercial globalization and the renaissance of scientific winemaking have added product convenience and quality consistency to the potential benefits of new and daring closure alternatives to natural cork.

Today, producers and consumers can choose from many types of wine closures. Wine packaging (probably one of the most challenging of all food barriers) has certainly evolved from the days when the product was transported, stored, and sold in Egyptian amphorae or medieval wooden barrels.[3]

For the last ten years, three types of wine closures have clearly dominated the market: natural corks, synthetics, and screw caps or screw tops (also known as Roll On Tamper Evident or ROTE). Other types of closures are also available, such as Vino-Seal, and Zork. Nevertheless, this article will focus on the first three types of closures and establish useful comparisons between the three systems.

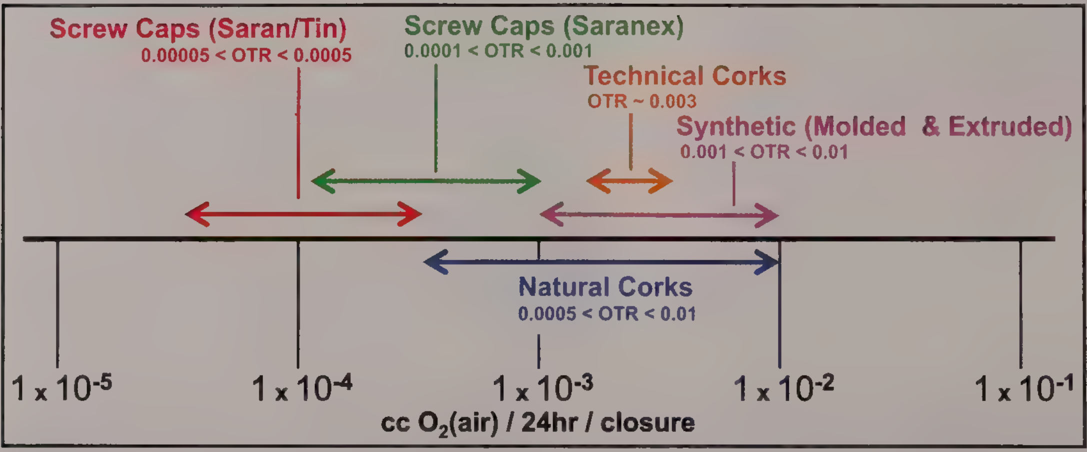

FIGURE 3: Oxygen Transmission Rates for the most widely-used wine closures (based on air measurements).

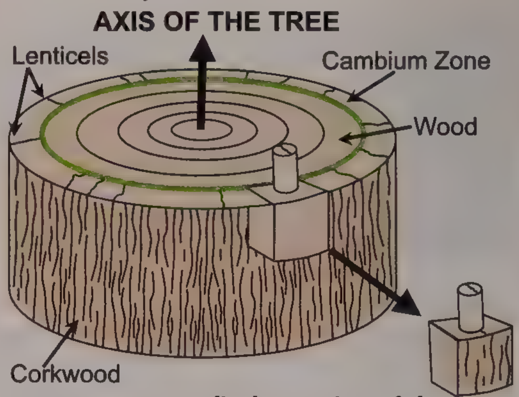

FIGURE 1: Perpendicular section of the *Quercus suber* tree showing wood, cambium zone, and corkwood. Natural corks are punched from the corkwood in a direction parallel to the axis of the tree.

Natural Cork

Closures made from cork material come from the bark of *Quercus suber*, a native oak tree that grows in the Mediterranean region. Most natural cork closures are manufactured in Iberia, primarily in Portugal.

The bark is harvested every nine years from mature trees between the months of June and August. Corkwood, once aged, conditioned, and cleaned, is sliced in sections proportional to the length of the closure and punched parallel to the axis of the trunk of the tree (Figure 1). Then, the corks are rectified (sanded), peroxide-washed (to whiten them), sorted by visual grades,[4] and bagged in quantities of usually 10,000 corks (a bale). At this point, the corks are exported to wine-producing regions throughout the world where they are then printed,

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moisturized, and treated (usually with paraffin and silicone).

The spent corkwood, a byproduct of the natural cork punching, is not wasted but used to manufacture "technical" corks. The material is ground and the cork granules are sorted by particle size. Through various cleaning techniques, the particles are washed to reduce or eliminate any traces of potential taint and/or other unusual aromas. The cork granules are finally glued together to make micro-agglos, 1+1s (dual disk), and champagne cork closures.

Synthetic Closures

Synthetic closures first appeared in the early 1990s and were probably the first wine sealing alternative that significantly competed with natural cork. They are mostly made out of a combination of polyethylene and other trade-secret adjuvants. There are two types of synthetics with two distinct manufacturing technologies: injection-molded and co-extruded polymer.

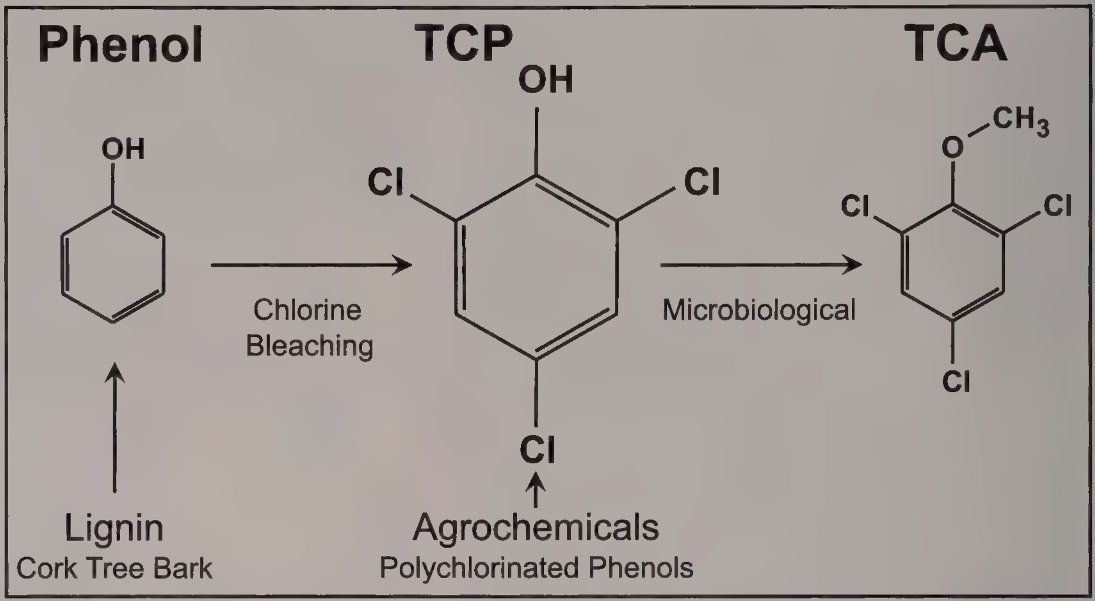
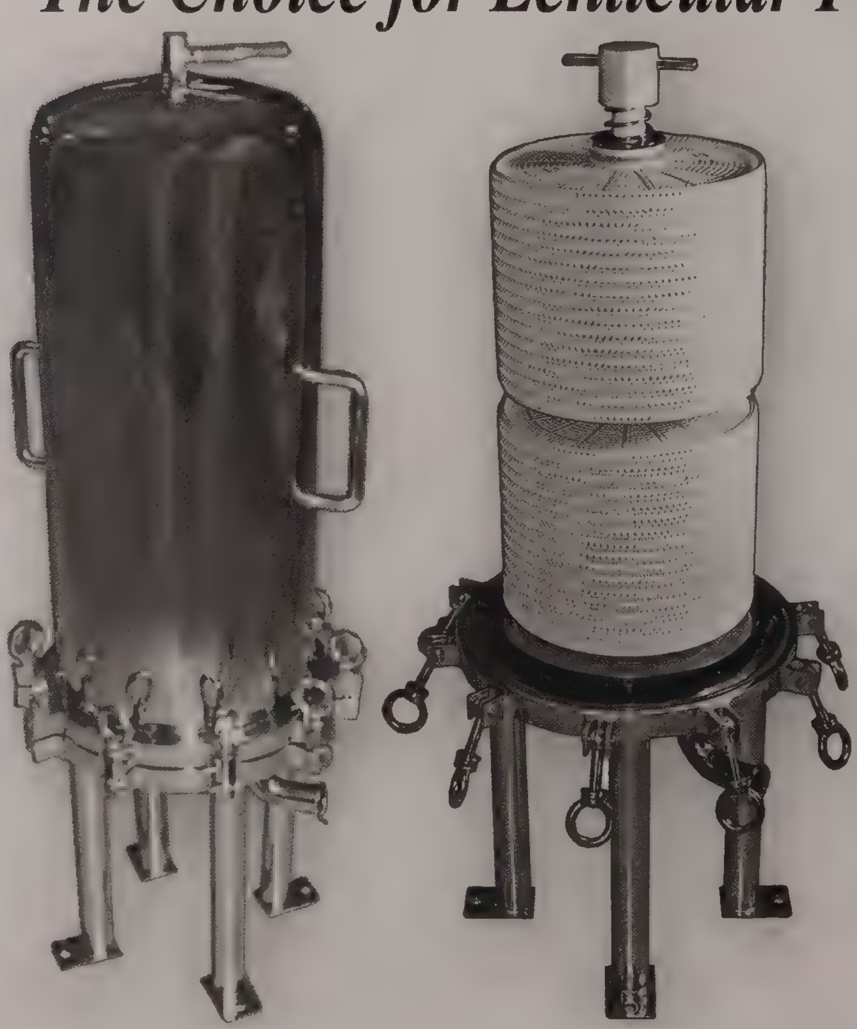


FIGURE 2: Biochemical pathway of formation of 2,4,6 trichloroanisole (TCA) from lignin and chlorinated fungicides.

Some of the first attempts to create a synthetic closure yielded products that were difficult to extract from the bottle, lacked the resilience of natural cork and therefore created a few problems during and after bottling. Other issues included excessive oxygen transmission rates, resulting in premature wine oxidation. However, by the late 1990s, most of these problems were being resolved and today synthetics are a popular choice for



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Screw Caps

The idea for sealing wine with a film barrier under an aluminum cap (that emulated a classic bottle capsule) was first developed during the late 1950s and early 1960s. Screw caps with various types of liners had been used on dessert wines and low-cost jug wines during the following years, and were sporadically applied to higher quality wines with mixed results.

Early attempts met much consumer resistance because they had a long association with cheap finished products. Also, the first screw cap liners created some problems during wine ageing, because the barrier requirements were not totally understood and perfected. Even though the screw cap still is an evolving closure, by the turn of the 21st century, it became the wine closure of the new millennium and was gaining wide acceptance in Australia, New Zealand, and Great Britain.

Today, there are basically two types of screw cap liners made with Saran™, (polyvinylidene chloride [PVDC]), an extremely heavy fiber with a remarkable barrier against water, oxygen, and foreign aromas. The Saran/Tin liner is a lamination of Saran™ combined with an impervious thin layer of tin metal. The Saranex™ liner has multilayered films of Saran™, co-extruded and integrally sandwiched between outer layers of other polymers. The Saran/Tin liner provides a greater barrier against oxygen than the Saranex liner.

Considerations in choosing a closure type

Personal, financial, and technical reasons lead winemakers to choose one type of closure over another. Some winemakers are traditionalists and appreciate the qualities of natural cork, even if they have to accept a low rate of tainted bottles. Others will require total product consistency and would probably only look at man-made closures such as synthetics or screw caps. Environmental concerns also play a big role in the decision-making process. Closure cost and sub-type classification differences, particularly for natural corks, are as wide as differences in the prices of wine offered by the market.

Certain technical considerations must be accounted for before, during, and after bottling. Wine style and preparation, expertise during closure application, equipment availability and/or investment, closure robustness, and the logistics of product storage, transportation, and commercialization must all be kept in mind in selecting a closure type.

Comparisons

A systematic approach for looking at closure selection includes five factors.

- CLOSURE TAINT

This might not be the most important reason for closure selection, but it certainly has been the original impetus

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for why, today, there are multiple choices of wine closures. TCA, probably the most significant cork taint, is a biochemical transformation product that starts in the bark of the cork tree.[5] The process has been summarized in Figure 2. This pathway of formation was ironically encouraged by the use of chlorine as a bark disinfectant and cork bleaching agent.

However, this practice was discontinued by the mid-1990s, and increased quality control gates and improved processing procedures were developed. Today, taint levels have come down to an average rate of 1% to 2%, depending on what releasable TCA (RTCA) level is considered unacceptable.[6]

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Therefore, it is important to understand that there will be some degree of TCA taint if natural cork is chosen to close a particular bottling. However, this does not mean that wines closed with other types of closures are totally free of any threat of taint. The raw materials used to manufacture synthetics and screw cap liners have adsorbing capabilities for volatile organic compounds (VOCs) which can migrate from packing materials (cardboard and wood pallets), contaminated warehouses, and cargo containers.[7,8]

Adsorbed VOCs can be a significant sensory threat to food, food packaging, personal care products, and even medications.[9,10] Therefore, it is recommended that synthetics and screw caps warehoused for prolonged periods of time be tested for potential contaminants, the same way natural cork is QC-tested for TCA upon arrival in the U.S.[11]

- Oxygen Transmission Rate (OTR)

This is probably the single most important factor to consider during closure selection. Oxygen transmission is the amount of oxygen gas that permeates into the sealed wine through the applied closure. It is typically expressed in cubic centimeters (cc) of oxygen per 24 hours per closure.

Figure 3 gathers and compares OTR values of natural and technical corks, synthetic (extruded and molded), and screw cap (Saran/Tin and Saranex™) closures.[12,13] The OTR values in Figure 3 represent only estimated OTR values that were collected from literature references, product specifications, and Cork Supply analysis (mostly on natural and technical corks). The order of closure type (based on OTR values) is more accurate and should be taken into consideration rather than focusing on specific or discrete oxygen transmission values.

It is important to understand that closure OTR values have been determined using various types of analytical techniques causing disagreement between suppliers and scientists. Number of replicates, attention to detail during testing, and closure application on a glass sleeve (if MOCON technique is chosen for measurement) can have a

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significant impact on the final OTR result. OTR values can be measured based on pure oxygen or air (20% oxygen). Therefore, measured OTR values based on pure oxygen are five times larger than values obtained with air.

Figure 3 includes a wide range of oxygen transmission rates for natural corks (from about 5.0×10^{-4} to about 1.0×10^{-2} cc/day/closure). As the visual quality of the cork moves from the best to least, the average OTR value will become larger due to a greater incidence of individual outliers (the OTR standard deviation will widen as the number of lenticels and imperfections increases in a lot of natural corks). This is why wine closed in bottles with natural corks from the very same lot might evolve into products with slightly different flavor nuances.

The cork industry is working to develop ways to sort natural corks, not only by visual grades but also by oxygen transmission rates. In the near future, winemakers may see further reduction in cork taint and improved OTR consistency with natural corks.

There are synthetics (extruded and molded), technical corks, and screw caps with Saranex™ liners with decreasing OTR values (values of around 7.0×10^{-3}, 3.0×10^{-3}, and 1.0×10^{-3} cc/day/closure, respectively). OTR values for technical corks are more discrete (narrow ranges) than natural corks, while there are wide ranges for synthetic and screw cap (Saranex™ liner) closures that are due not to product inconsistency (just the opposite) but rather due to the wide selection of availabile products (with several OTR values).

On the other extreme of the spectrum are Saran/Tin screw caps with impermeable tin layers. Given the low OTR nature of Saran/Tin liners (approximately 1.0×10^{-4} cc/day/closure), screw cap application requires careful consideration due to the potential for wine reduction to occur during storage and cellaring. Reduction is a chemical process which occurs in the absence of oxygen resulting in unpleasant aromas due to the formation of certain sulfur-containing volatile compounds.

It is important to consider how the screw cap liner is shaped during closure application in order to protect the wine from oxygen. As the closure is put in place during bottling, the aluminum cap presses the wafer-shaped liner against the glass bottle by thinning and stretching the circumference of the liner over and around the rim of the bottle neck in a "reform" process. Depending on how much head block pressure is applied, the density of the polymers sandwiched between glass and aluminum will determine the actual oxygen transmission through the molded barrier.

It is sometimes difficult to report a discrete OTR value for screw caps (Saranex™ and Saran/Tin) as product specification. In this respect, it is more appropriate to report a range of OTR values. Nevertheless, if proper QA procedures are in place, screw

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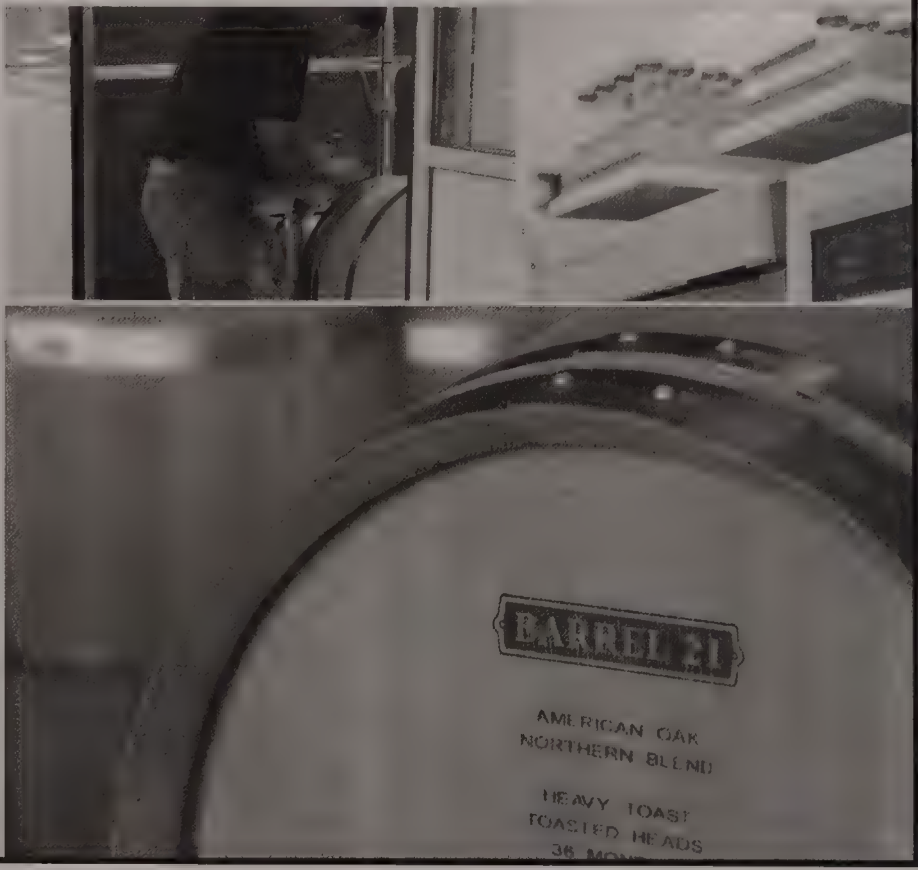

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cap application should provide expected product consistency within a bottling event.

- Closure Application

Equipment for natural cork (which can also be employed for technical cork and synthetic closures) has been available for years, so technical assistance is easy to find when adjustments and repairs are necessary.

In contrast to the equipment built for insertable closures (naturals, technicals, and synthetics), the entrance of screw cap machinery into the wine industry is fairly recent and carries a higher degree of technical sophistication. Head block, thread, and skirt roller pressures, type and height of rollers, and exact dimensions and angles of glass bottle design in relation to the dimensions of the aluminum screw cap are all important factors to observe in order to achieve desired bottling results.

There are differences in performance across the range of natural corks and synthetic closures. Hence it is important that bottling conditions are optimized for each closure type. Otherwise issues such as "suck ins," "push outs," and leakage can occur. Improperly maintained equipment (particularly corker jaws) can result in closure damage during bottling leading to leakage and other problems.

Screw cap equipment is not only costly, but requires exact precision during application. Screw cap equipment with improper settings can not only lead to ugly external applications, but seriously compromise the sealing specifications of the delicate top liner. To make things more complex, these mistakes might not be apparent on bottling day but later during product storage. However, like other critical characteristics, these specifications can generally be controlled with good bottling QA protocols.

- Closure Robustness

The true quality of a wine closure is shown when it is submitted to abusive conditions while delivering the expected results. Specification deviation not only can occur as a consequence of the bottling event, but also during final product storage and transportation.

Proper bottling temperature, fill height (ullage), and final headspace pressure all need to conform to the specifications of each closure/bottle combination. In the case of inserted closures (natural cork, technical cork, and synthetic closure), appropriate bottle neck diameter and taper are required for an optimum seal.

Periodically, glass bottles with unexpected neck tapers appear in the market. These bottles can seriously affect the seal of some of the longer-length corks, resulting in closures with no or very low compression values at the bottom end, which can cause cork wicking.

It is always advisable to confirm neck diameter and taper with a bottle neck profile analysis. In the case of screw caps, besides the potential defects outlined under closure application, it is impor-

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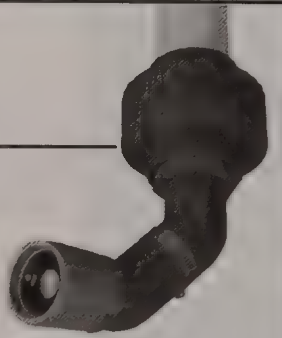

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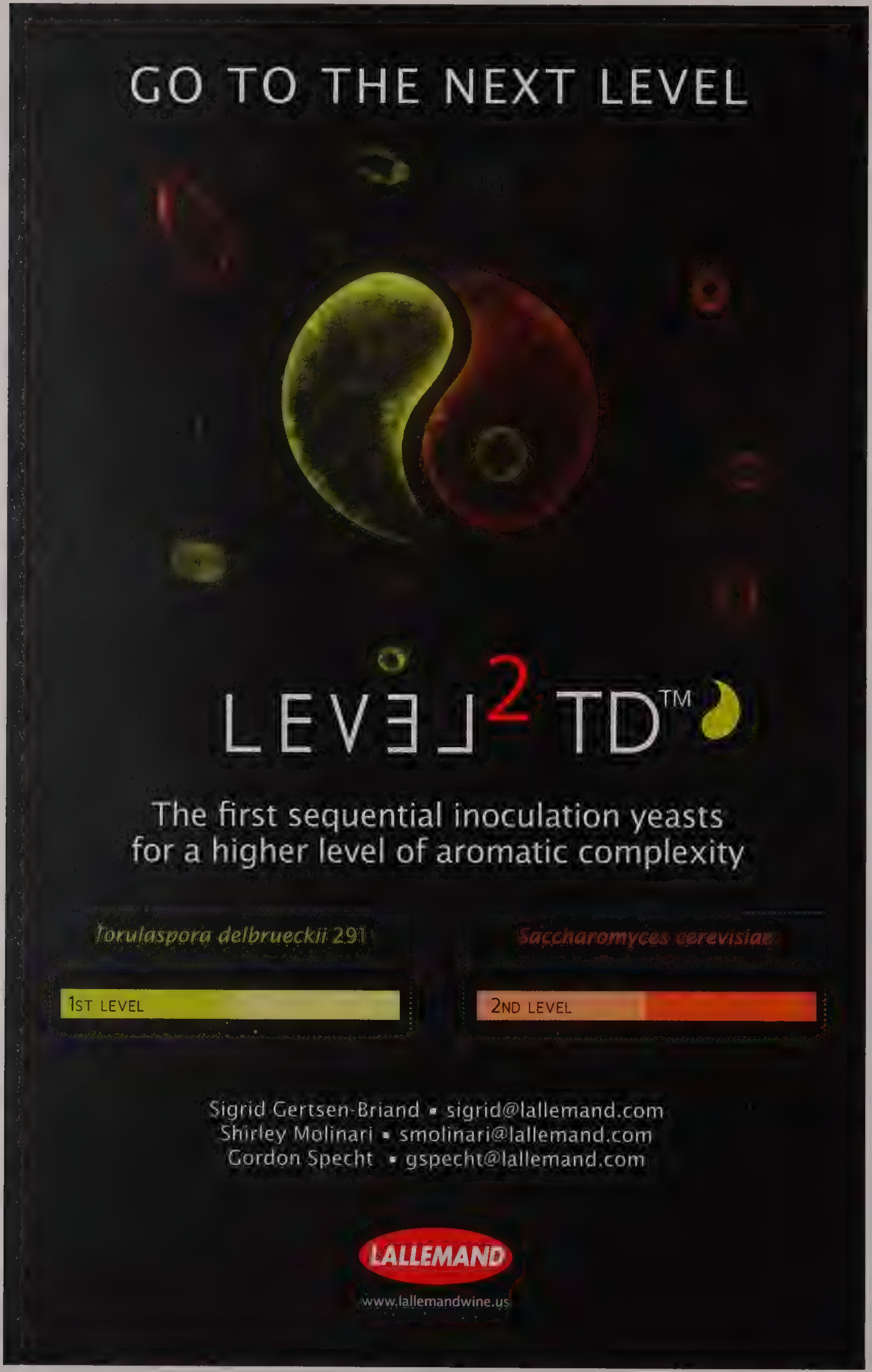
tant to procure glass bottles with even neck rims and no top surface imperfections; otherwise partial liner compression and cut-through could occur.

If expansion due to elevated wine temperatures during distribution exceeds the headspace volume, seal failure will occur. When wine bottles are stored and/or transported at higher than recommended temperatures, natural cork typically shows signs of wicking or leaking, while synthetic closures often push up or leak. Bottles closed with screw caps require extra care during industrial handling so the top part/circumference is not dented. If so, the seal of the liner could be compromised, resulting in random premature wine oxidation.



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- ENVIRONMENTAL CONSIDERATIONS

One final consideration is the impact of the closure on the environment. Recently, this impact has been measured as the carbon footprint contributed by one (or one million) unit(s). Studies have indicated that the carbon footprint values of different closure categories claim varying results. However, it is generally accepted that natural corks contribute the least, followed by synthetic closures, and technical corks, with screw caps contributing significantly more.[14,15] ■

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INNOVATIVE TOOL FOR WINEMAKERS

Sequential inoculation with a non-*Saccharomyces* yeast and a *Saccharomyces cerevisiae* yeast

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Forbes Wardrop,[2]
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Alcoholic fermentation was a risky process in the past, when it was carried out by wild yeasts present in the winery. The conversion of sugars into alcohol and the production of aromatic compounds occurred by sheer luck, making alcoholic fermentation an uncertain process. Clearly, the qualitative risks were very real. Aromatic deviations, such as *piqûre acétique* and other problems related to fermentation, were frequent.

The addition of selected yeasts in an active dry form has gradually changed practices and made alcoholic fermentation much more reliable.

Studies comparing yeast ecologies in vineyards and cellars clearly show that the yeasts present on grapes are subject to such natural phenomenon as grape maturity and weather, and to human intervention such as phytosanitary treatments.[5,22] These studies also show that residual indigenous yeasts are often the yeasts most appropriate for carrying out alcoholic fermentation.

The addition of selected *Saccharomyces* yeasts reduces unreliability due to the development of uncontroleded indigenous populations, and ensures smooth alcoholic fermentation. The result is an improvement in the overall quality of the wines,[29] and in the coherence of production processes.[20,27]

The diversity of the yeast microflora present in the vineyards,[15,35] musts,[22,24,25,42] and during the first stages of winemaking also affect wine quality.[46] The involvement of non-*Saccharomyces*-type microorganisms in alcoholic fermentation has been described by scientists.[10,17,41]

Wines can benefit from the quantitative and qualitative diversity of the products and by-products of fermentation obtained through non-*Saccharomyces* yeasts.[9,11,19] Due to this biodiversity, the winemaker can make selections to better differentiate a wine or to reveal the aromatic potential, in terms of both intensity and complexity.[17, 38,39,44]

According to recent research, certain non-*Saccharomyces* yeasts have interest-

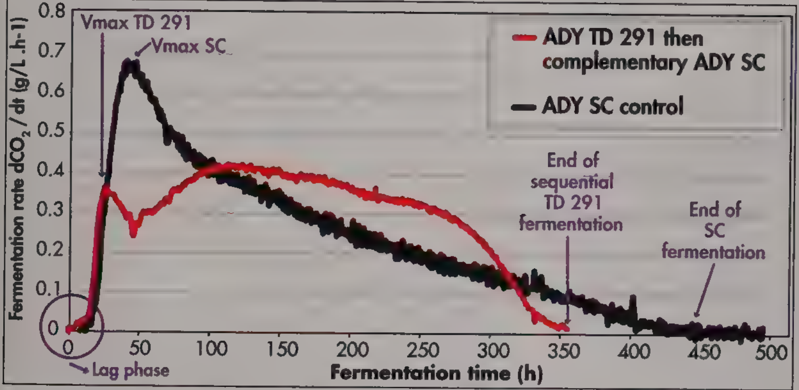

FIGURE 3: Fermentation kinetics of sequential inoculation and classic inoculation in a deficient must.

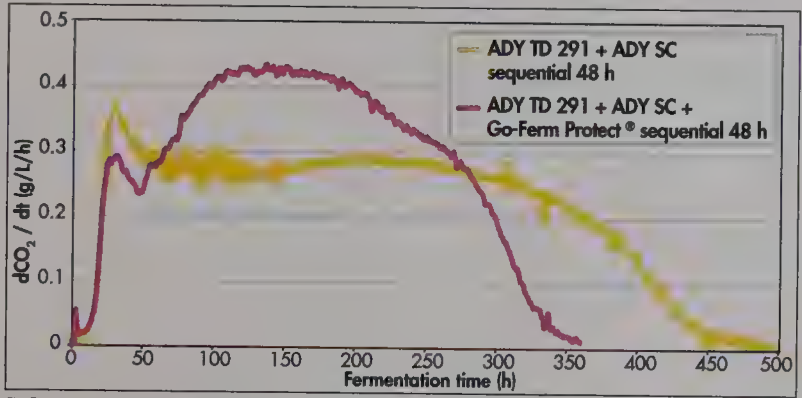

FIGURE 4: Fermentation kinetics with and without a yeast protectant during the rehydration of *Saccharomyces cerevisaie* in sequential inoculation with *Torulaspora delbrueckii* 291.

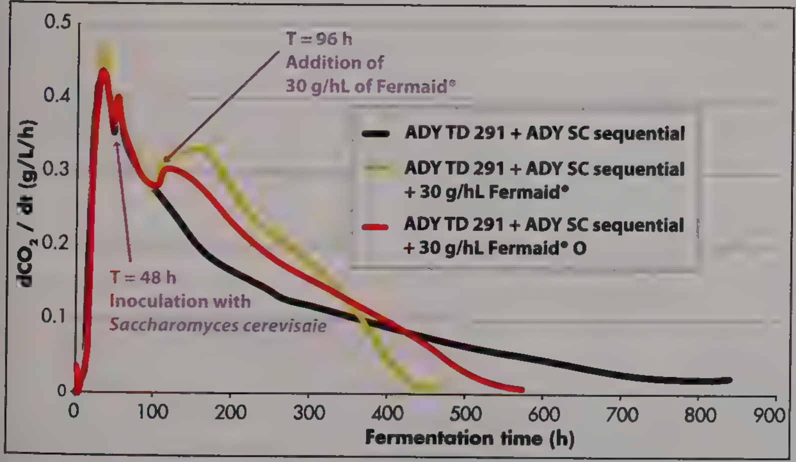

FIGURE 5: Fermentation kinetics with different nutrition strategies for the yeasts utilized in sequential inoculation.

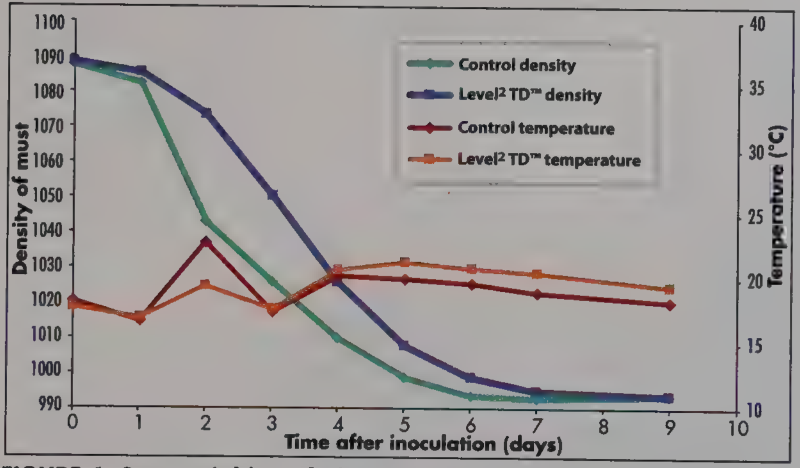

FIGURE 6: Sequential inoculation compared to classic inoculation fermentation kinetics in a Chardonnay must.

ing sensory influences on winemaking. Lallemand's research on the aromatic potential of non-*Saccharomyces* yeasts, combined with optimization of the production of these yeasts in dry form, now lets a winemaker take advantage of fermenting with non-*Saccharomyces* wine yeasts while maintaining control over the fermentation process.

These new tools combine biodiversity, reliability, and qualitative advantages.

Production of Torulaspora delbrueckii yeast with high viability and vitality – What makes the *Torulaspora delbrueckii* species interesting?

Within the biodiversity naturally present on the grape and in the fermentation ecosystem, certain yeasts have been studied for their sensory contributions in enological fermentation.

We are particularly interested in the *Torulaspora, Candida, Debaryomyces, Pichia, Kloeckera, Kluyveromyces,* and *Metschnikowia* genera, among others.[3,10,11,17,33,40] *T. delbrueckii* stands out, not only for revealing typicity, but for the pureness of its fermentation profile,[8,30,32,34] and its capacity to correct certain faults in wines, such as volatile acidity.[2,28]

As variability is the standard in nature, whether inter- or intra-species,[37] the choice of working with a precise strain of *T. delbrueckii* was made in partnership with the Institut National de la Recherche Agronomique (INRA) in France, after winemaking trials and according to the yeast population and sensory analyses, while respecting all AFNOR standards.[28] (AFNOR is the Association française de normalisation, the French national standardization organization.)

The survival rate, capacity to multiply, and fermentation pureness of Torulaspora delbrueckii –

Different strategies for producing active dry yeast (ADY) from *T. delbrueckii* (Lallemand yeast collection number 291) were developed to increase the survival rate under difficult enological conditions and to increase the yeast's capacity to multiply so that it can establish itself in grape must.

In the following example, *T. delbrueckii* 291 yeasts resulting from different production lots were coded "ADY TD1" and "ADY TD2" and tested. The must utilized was a grape juice from the Viognier variety, and the standard analyses are presented in Table I. As this natural must presents low turbidity, and therefore has low concentrations of micronutrients and survival factors, it is an environment recognized as hostile to yeasts in general and to non-*Saccharomyces* yeasts in particular. The fermentation temperature applied to these fermentations was 20°C.

In parallel, and in order to compare the survival capacities of non-*Saccharomyces* yeasts, a selected *Saccharomyces cerevisiae* yeast recognized the world over for making high-quality white

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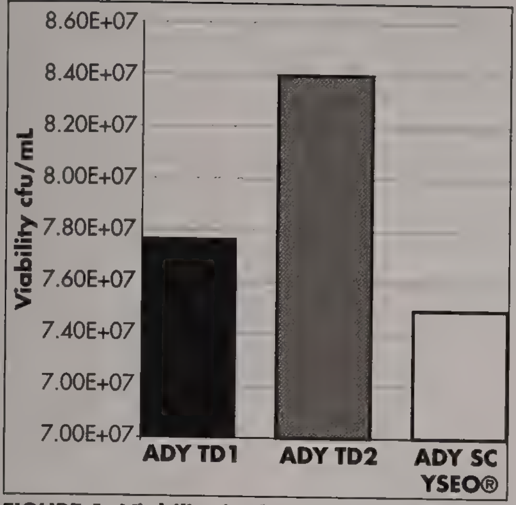

FIGURE 1: Viability in the musts of different non-*Saccharomyces* yeast, after 50 hours of alcoholic fermentations.

wines was added. In addition, this control yeast was produced according to the YSEO® (Yeast Security Optimization) process. This yeast was coded "ADY SC YSEO®."

The viability of each of these three yeasts is presented in Table II. The minimum viability required for reliable fermentation is 1x10^{10} cfu/g of ADY. Therefore, all yeasts utilized exceeded quality standards.

Control of the viability of yeasts inoculated into the must and yeast count were done 50 hours after the maximum rate of fermentation was reached. The yeast count was done by spreading on Sabouraud agar plates and adding 0.055 g/L of methylene blue to permit morphologic differentiation. This method had already been checked and validated through genetic analysis. The results are presented in Figure 1. In parallel, the capacity of the ADY TD1 and ADY TD2 yeasts to multiply — their "vitality" — was compared. Those results are presented in Figure 2. The reliability of the process for controling the hygiene of the

Sugar g/L	Turbidity NTU	Available nitrogen mg/L	pH	Total H_2SO_4 g/L
215	42	150	3.65	2.50

Table I: Standard Analysis of the Viognier must utilized.

ADY	Viability cfu/g
ADY TD1	4x10^{10}
ADY TD2	2x10^{10}
ADY SC YSEO®	4x10^{10}

Table II: Viability of different yeasts.

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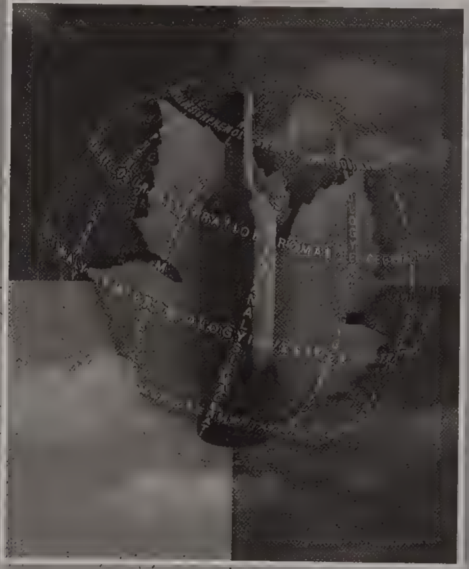
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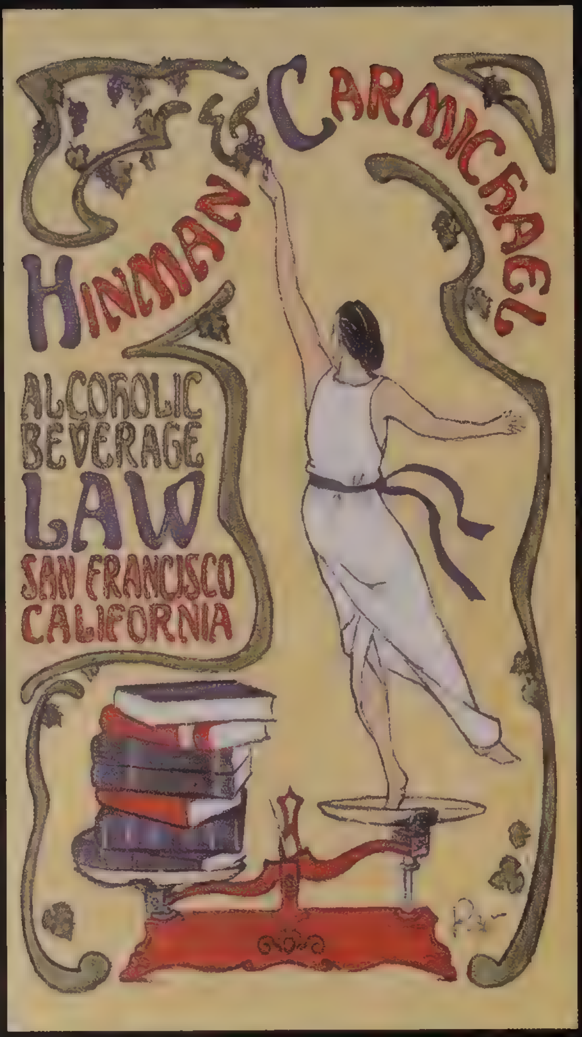

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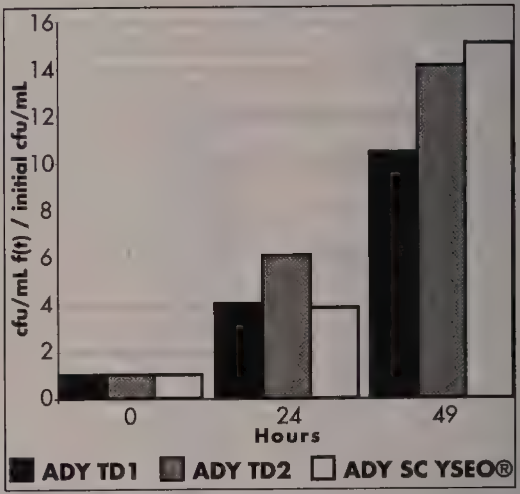

FIGURE 2: Vitality, or the capacity to multiply of different yeasts, during the first 50 hours of alcoholic fermentation.

wines is presented in Table III, which shows the standard analysis of the resulting wines.

The results show that, according to how the yeasts are produced, the viability at the time of inoculation and the capacity for multiplication (or vitality), can be predicted. The ADY TD2 yeast appears to be the better-performing product in terms of vitality and viability compared to ADY TD1. The ability of *T. delbrueckii* 291 to ferment under difficult conditions when there are survival factor deficiencies (such as sterols, due to the low turbidity of the must), was observed.

Yeast viability is important in order to take hold and dominate over the indigenous yeasts, but the capacity to multiply is also essential, as it is during the multiplication phase of yeasts that the main fermentation aromas are synthesized. What's more, it has already been shown that to contribute to the sensory profile of wines, most of the non-*Saccharomyces* yeasts must reach a large total population, on the order of 10^6 or 10^7 cells per milliliter.[24]

Today, adaptations to ADY production processes allow production of non-*Saccharomyces* yeasts that meet the need for viability and vitality as reliably as active dry *Saccharomyces cerevisiae* yeasts.

Strategy for adding Torulaspora delbrueckii 291 in sequential inoculation –

It is generally believed that adding non-*Saccharomyces* yeasts to a monoculture does not allow the proper and reliable completion of fermenta-

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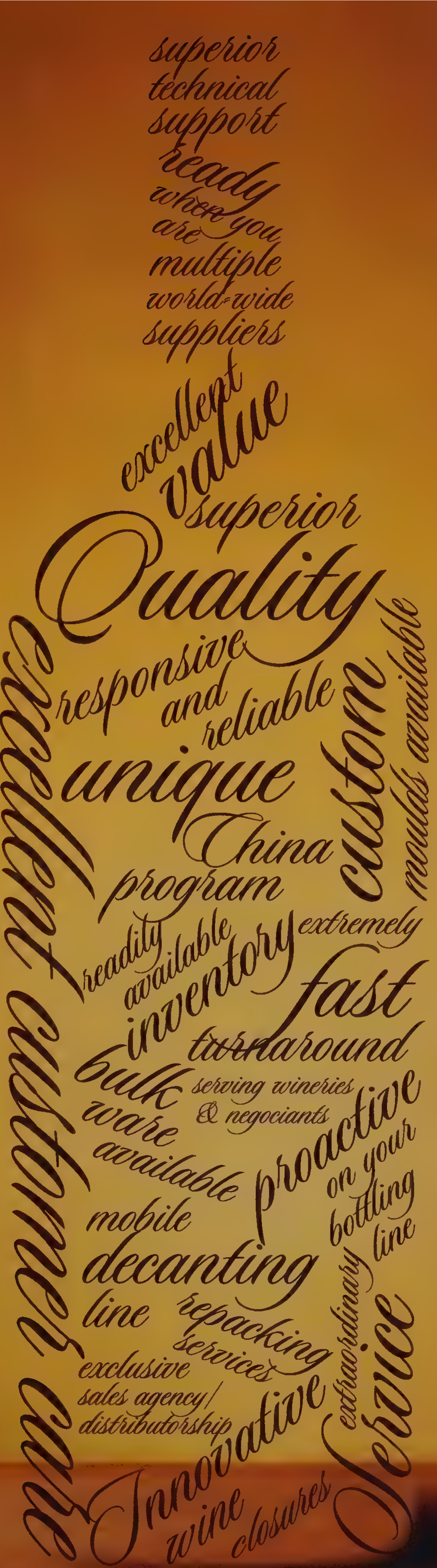

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[redacted]	Total Alcohol (% vol.)	Glucose-Fructose (g/L)	Total SO_2	Free SO_2	Volatile acid H_2SO_4 (g/L)	Total acidity H_2SO_4 g/L	pH
TD1 then SC YSEO® in sequential inoculation	12.72	0.0	14	6	0.17	2.50	3.73
TD2 then SC YSEO® in sequential inoculation	12.72	0.0	14	6	0.12	2.60	3.73
SC YSEO®	12.83	0.0	16	8	0.23	3.10	3.63

Table III: Standard Analysis for Viognier wines.

tion (with residual sugars less than 2 g/L) within a timeframe compatible with current winemaking requirements, while guaranteeing the absence of organoleptic faults.

In enological conditions, these species have limited fermentation capacities compared to *Saccharomyces* yeast, due notably to their low capacity to multiply and their particular needs for micronutrients and oxygen. [23,32] However, because it is extremely adaptable to hostile conditions, *Saccharomyces* yeast manages to grow and surpass the indigenous non-*Saccharomyces* yeasts.[20]

It has been widely reported that the succession of yeast populations, with the sequential domination of a non-*Saccharomyces* yeast in the first phase of alcoholic fermentation followed by a *Saccharomyces* yeast, can contribute to the aromatic complexity of wines,[19,45] and this theory was validated in a previous study.[28] The succession of yeast populations, such as those obtained with this selected strain of *T. delbrueckii* 291, thus contributes to a more complex sensory profile. This sequential inoculation avoids putting the sensory and fermentation qualities of each species into competition.

The first trials consisted of optimizing the yeast pairing. Several *Saccharomyces* yeasts were tested with the *T. delbrueckii* 291 strain in sequential inoculation, on several varietals and in diverse fermentation conditions. Among the *S. cerevisiae* yeasts, selected because they corresponded to set criteria, a single strain proved to be compatible with the *T. delbrueckii* 291 for obtaining wines with a distinctly positive aroma profile.

Course of the sequential fermentation –

A synthetic must ("MS300-FA-O2 GF"), which mimics extreme deficiencies in sterols, was utilized. This must presented a glucose-fructose level of 200 g/L, and was devoid of sterol-type survival factors.

In addition, it was made inert through direct bubbling with ALIGAL™ before

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inoculation with the *T. delbrueckii* ADY TD 291 and the control yeast, *Saccharomyces* ADY SC, so that no oxygen was dissolved in the must. Therefore, the fermentation conditions were extreme and allowed us to verify whether sequential inoculations with the active dry *T. delbrueckii* 291 and *Saccharomyces* yeasts are compatible in this type of situation. Given these particularly difficult conditions, Go-Ferm Protect® yeast rehydration protectant was added to the active dry yeasts during rehydration, following the producer's recommendations.

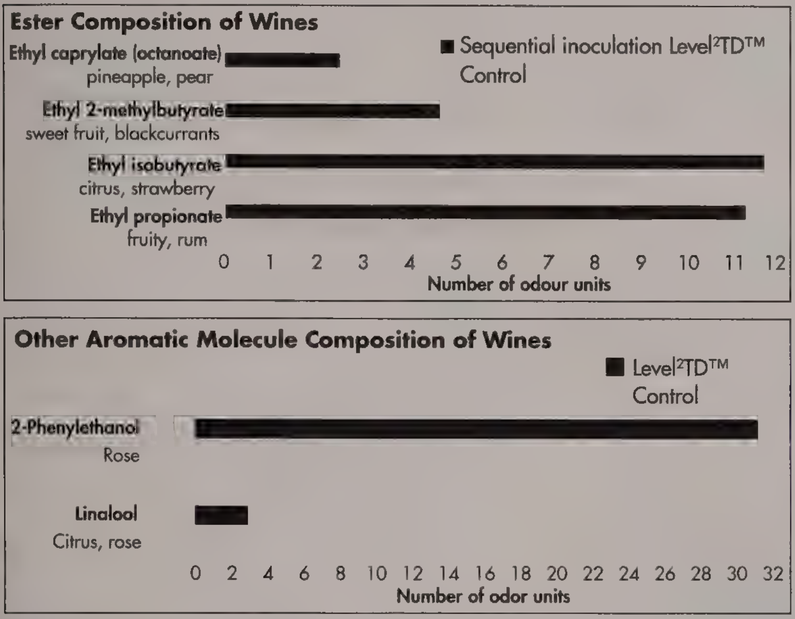
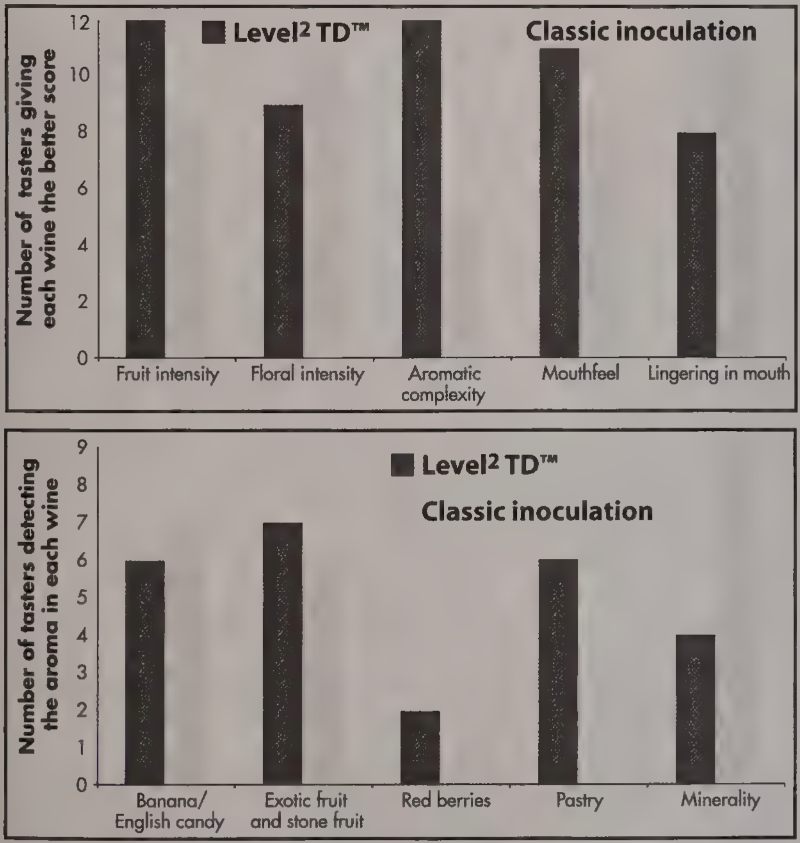


FIGURE 7A and 7B: Chardonnay: Number of olfactive units (ratio/ perception threshold) for different aromatic molecules for each process.



Figures9A and 9B: Chardonnay: Results of descriptive sensory analysis carried out by a non-professional consumer panel.

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Fermentation rates for both trials are in Figure 3. The standard wine analyses are in Table IV.

The fermentation kinetics obtained (Figure 3) show that the lag phase is extremely short, both for the fermentation inoculated with ADY TD 291 and the control fermentation inoculated with ADY SC. The maximum rate of fermentation (Vmax) is slower in the case of the sequential inoculation, but it is nearly constant in the stationary phase. The end of fermentation is more abrupt than in the control. The absence of a fermentation peak during the sequential inoculation avoids a thermal increase, often associated with alcoholic fermentation.

Characterization of the Saccharomyces cerevisiae/ Torulaspora delbrueckii 291 pairing in sequential inoculation –

Utilizing a protectant for *Saccharomyces cerevisiae* yeast in sequential inoculation –

To assess the fermentation capacities of sequential inoculation in extreme conditions in regards to oxygen and to study the relevance of adding a rehydration protectant to *S. Cerevisiae*, several fermentation trials were conducted. The results show that under difficult fermentation conditions (a deficient must), it is preferable to utilize a yeast protectant for *Saccharomyces* yeast (Figure 4).

The impact of the yeast protectant is visible in Figure 4 in terms of the fermentation rate. By utilizing a protectant for the rehydration of *S. cerevisiae*, the length of fermentation was reduced by 25% compared to the control fermentation (with no protectant). This presents a real advantage considering that the fermentation time is generally longer when making wine through sequential inoculation.

Assessing nitrogen demand for the optimized pairing utilized in sequential inoculation –

In order to determine nitrogen demand when utilizing two yeasts in sequential inoculation, alcoholic fermentation was carried out on synthetic musts deficient in available nitrogen. The duration of fermentation in a medium deficient in nitrogen is proportional to the nitrogen necessary to maintain a constant fermentation rate in this medium.[26] Yeasts described as having low, medium, or high nitrogen demand were compared to yeast pairings utilized in sequential fermentation. The resulting fermentation kinetics place the *T. delbrueckii* 291 yeast in the category with a high demand for nitrogen.

	Total Alcohol (% vol.)	Glucose-Fructose (g/L)	Total SO_2	Free SO_2	Volatile acid H_2SO_4 (g/L)	Total acidity H_2SO_4 g/L	pH
TD291 then SC YSEO® in sequential inoculation	12.09	0.0	<25	<5	0.33	7.67	3.53
SC YSEO®	12.83	0.1	<25	<5	0.79	8.35	3.45

Table IV: Standard analysis of wines made with MS300-FA-02 GF synthetic must.

Optimized nutrition for the yeast pair in sequential inoculation –

Laboratory results show that the high nitrogen demand of the yeast pair utilized in sequential fermentation was supported, according to observations during the winery scale trials. The adapted nutrition strategies were then studied in the laboratory and validated during winery trials. In the laboratory, the medium utilized was lacking in anaerobic factors (survival factors), mimicking a total lack of sterols and lipids, and the yeast available nitrogen (YAN) levels were on the order of 100 mg/L. The fermentation temperature was maintained at a constant 20°C and the initial sugar level was 220 g/L.

Two different yeast nutrition strategies were carried out:

- Addition of a nutrient called "complex" for its balanced levels of organic and inorganic nitrogen. This nutrient also contains vitamins and inactivated yeasts — a source of sterols and unsaturated fatty acids.
- Addition of a 100% organic nutrient comprised only of nitrogen in the form of amino acids. Both these nutrition strategies were carried out during fermentation with the sequential inoculation of *Saccharomyces* ADY SC and *Torulaspora* ADY TD 291 yeasts.

In Figure 5, the appropriate nutrition allows a 54% reduction of the fermentation time with a complex nutrient and a 32% reduction with an organic nutrient supplement. The impact is huge in terms of fermentation reliability. These results are coherent with the high nitrogen needs assessed for the yeast pair.

A promising approach for lowering volatile acidity –

According to the results of trials utilizing sequential inoculation with *T. delbrueckii* 291 to facilitate the fermentation of late-harvest musts, this process would be particularly useful not only to improve the aromatic profile of wines, but to reduce volatile acidity (VA) as well — a problem generally associated with this type of fermentation.

Indeed, during a series of trials carried out in Sauternes, France, on a Semillon must with an alcohol potential of 21.4%, the degree of volatile acidity of the lot that underwent sequential inoculation was significantly lower than the lot that underwent classic inoculation (0.35 g/L instead of 0.70 g/L).

Sensory contribution of Torulaspora delbrueckii 291 in sequential fermentation

– Comparison with conventional *Saccharomyces cerevisiae*-type yeasts –

During a trial in a Chardonnay must (Table V) from the Mâcon-Villages AOC in France, we obtained very minor differences in terms of alcoholic fermentation (Figure 6) between the classic inoculation (control) with an active dry *S. cerevisiae* yeast, and sequential inoculation with *T. delbrueckii* 291 and *Saccharomyces* (Level^2 TD™ kit). However, significant differences became apparent after analysis of the aromatic compounds (see Figures 7a and 7b).

Esters – At the end of alcoholic fermentation (AF), the levels of ethyl hexanoate and ethyl butyrate, which intensify the fruity perception, were significantly higher in the trial wine (with sequential inoculation) than the control wine.

Other aromatic molecules – At the end of AF, the levels of linalool (citrus and rose) and 2-phenylethanol (floral notes) were higher in the lot fermented using Level^2 TD™.

Once malolactic fermentation was finished, a consumer panel expressed a clear preference for the wine made with Level^2 TD™ (Figure 8), declaring that its aromatic complexity was superior to the control wine. According to some panel members, the wine obtained through sequential inoculation presented positive aromatic notes of "pastry" that were not perceived in the control wine.

A significant difference in descriptors appeared between the two wines tasted by a consumer panel (Figures 9a and 9b). Notably, the wine resulting from Level^2 TD™ inoculation was perceived as having superior aromatic complexity, while not being less intense. Some of the tasters also perceived the presence of the "pastry" aromatic range in this wine, while no one detected it in the control wine.

ADY	Viability cfu/g
ADY TD1	4x10^{10}
ADY TD2	2x10^{10}
ADY SC YSEO®	4x10^{10}

Table II: Viability of different yeasts.

Conclusion

Five years of Lallemand research and development in the laboratory and yeast production facility, along with winery trials, confirm the winemaking benefits of a pair of complementary non-*Saccharomyces* and *Saccharomyces* yeasts, utilized in sequential inoculation and called "Level^2 TD™." Due to the numerous efforts to optimize the non-*Saccharomyces* yeast production process, the *T. delbrueckii* 291 yeast selected by Lallemand has an excellent survival rate after inoculation of the must.

During alcoholic fermentation, after a 15-point drop in density, the must is then inoculated with a *Saccharomyces cerevisiae* yeast selected specifically for its synergy with the *T. delbrueckii* 291.

The most striking impact of the synergy between these two yeasts is the complexity, aromatic intensity, and mouthfeel contribution they give to wines from many white grape varieties.

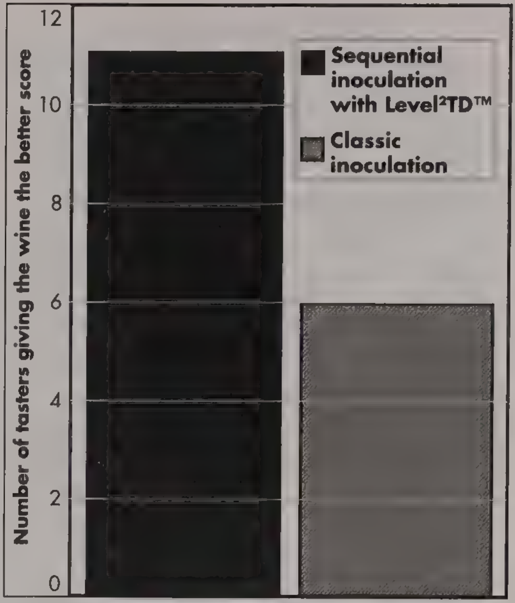

FIGURE 8: Comparative evaluation of both wines by a consumer panel after malolactic fermentation.

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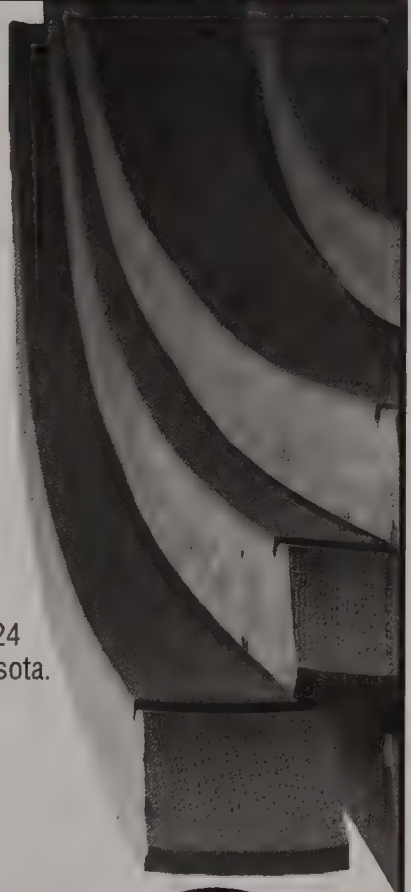
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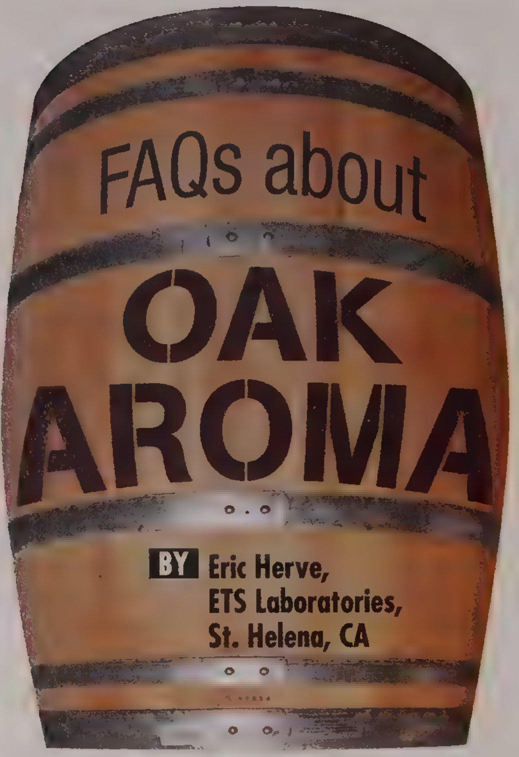

FAQs about OAK AROMA

BY Eric Herve,
ETS Laboratories,
St. Helena, CA

Q Why is there so much variation in oak aromas? Major sources of variation are the oak itself, growing conditions, and cooperage practices. These variations interact with each other, forming many potential aroma profiles.

Oak species differ greatly. The French pedunculate oak (*Quercus pedunculata* aka *Q. robur*) is known for its relatively faint aroma potential compared to French sessile oak (*Q. sessilis* aka *Q. petraea*). American white oak (*Q. alba*) can have a strong, distinctive aroma that is sometimes considered overpowering in certain wines. Oregon white oak (*Q. garryana*) seems to have more similarities to the French oaks than to American white oak.

Geographic origin is linked to botanic species, but different species frequently grow in the same forests, and hybridization does occur. Growing conditions, age, and genetic variation of individual trees can strongly affect wood structure and composition, with even a stave's position on a tree trunk influencing its aroma composition.

Stave seasoning and drying are important. Kiln drying is likely to result in a different aroma character than air drying. Air drying conditions (time spent in open air and humidity level) also have a significant influence on wood aroma potential.

The cooperage process adds a considerable layer of variability. Definitions of "light" to "heavy" toast are subjective and vary among coopers. Difficulty in controlling toasting levels creates barrel-to-barrel variation. In addition, stave-to-stave variation also occurs in the same barrel as some staves may toast more rapidly than others.

Q What is the effect of toasting on oak aroma? Toasting during barrel processing modifies the structure and chemical properties of the oak. This influences the wood aroma composition and consequently, the release of aroma compounds into the wine.

Increased toasting diminishes the fresh oak aromas generally attributed to oak lactones. Simultaneously, vanilla and caramel aromas associated with vanillin, furfural and 5-methylfurfural increase. At higher toast levels these compounds decrease and are replaced by spicy (eugenol, isoeugenol, 4-methylguaiacol), and smoky characters (guaiacol, 4-methylguaiacol).

Q How does barrel age affect oak aroma? Oak aroma potential decreases rapidly with barrel use. However, different compounds are extracted from oak at different rates. While a one-year-old barrel will impart less oak character to a wine than a new barrel, the aroma compounds it does contribute are likely to have a different profile than those of a new barrel. For example, smoky compounds (guaiacol, 4-methylguaiacol), located mostly on the surface of the staves, tend to be depleted faster.

Q How do winemaking processes influence the levels of oak aroma compounds actually present in wine? The choice of barrel type, proportion of new oak, and duration of oak contact are the primary factors influencing wine wood aroma, but microbial activity also has a strong influence.

Yeast, lactic acid bacteria, and spoilage microorganisms can interfere with oak aroma compounds. These interactions include simple adsorption on cell walls and macromolecules released by these microorganisms, absorption followed or not by biochemical modifications, and chemical reactions with metabolites released by these microorganisms.

During barrel fermentation, partial transformation of aldehydes such as vanillin, furfural, and 5-methylfurfural into non-aromatic alcohols usually occurs. This may cause a decrease in the overall impression of "oakiness."

On the other hand, furfural may also react with hydrogen sulfide (H_2S) produced by yeast forming furfurylthiol (aka furanemethanethiol). Furfurylthiol has an extremely powerful "roasted coffee" aroma, giving an impression of strong, toasted oak flavors. Furfurylthiol has a short lifespan, however, and often loses most of its sensory impact by the end of barrel ageing.

Adsorption of aroma compounds on yeast and bacterial cell walls and on wine macromolecules (polysaccharides, polyphenols) provides an explanation to what is described as the "integration" of oak aromas.

It is important to take these factors into account when comparing wines. A frequent application of the ETS oak aroma panel is barrel trials. A single wine is made and aged in barrels of various origins to compare aroma differences.

Sensory evaluation of the samples in-house by the winemaking team, and analytical testing by ETS are performed at scheduled intervals during the trial. Data interpretation is simple since the only variable is oak contact. A similar approach is commonly used to evaluate barrel alternatives.

Q Do *Brettanomyces* have an influence? *Brettanomyces* can influence perceived oak characters via possible adsorption of compounds on cell walls, absorption and metabolism of oak aroma compounds, and by the release of 4-ethylphenol (4EP) and 4-ethylguaiacol (4EG).

Generally, 4EP and 4EG have a masking effect on wine aromas. On the other hand, the chemical similarities of 4EP and 4EG with the spicy/smoky volatile phenols produced from oak

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toasting may result in additive sensory effects and perception.

Periodic monitoring of *Brettanomyces* activity with 4EP/4EG and/or Scorpions® analysis is recommended during oak ageing. When submitting samples for the oak aroma panel, checking 4EP/4EG levels makes sense due to their interactions with oak aroma compounds, especially when results will be compared to sensory evaluation data.

Q What are the sensory thresholds for compounds reported in the ETS Panel? Reported thresholds for pure compounds in hydroalcoholic solution are reported in Table I. Note they do not perfectly describe a compound's sensory impact on wine, since the wine matrix is more complex and interactions between compounds, are not taken into account.

Q What really is the sensory impact of the compounds? *Cis*-oak lactone and vanillin are strong impact compounds; often present in oaked wines several levels above their individual odor threshold. *Trans*-oak lactone, eugenol, guaiacol, and 4-methylguaiacol are often present in quantities close to their individual threshold levels, and get most of their impact from additive and synergistic interactions with chemically-related compounds (compounds of a same "family").

Furfural and 5-methylfurfural are usually found in levels below their odor thresholds, especially in red wines where they may be involved in polymerization reactions with polyphenols, but are still useful indicators of the caramelization products "family."

Q How can compounds below their sensory threshold contribute to wine aroma? Substances from a same chemical "family" are often formed and released from oak as a group. It is the combined effect of these similar compounds that causes the perceived sensory effect.

Table I
Sensory threshold in a model wine solution (Chatonnet 1995)

Cis-oak lactone	25 µg/L
Trans-oak lactone	110 µg/L
Vanillin	65 µg/L
Eugenol	15 µg/L
Guaiacol	20 µg/L
4-Methylguaiacol	30 µg/L
Furfural	15.000 µg/L
5-Methylfurfural	16.000 µg/L

For example, caramelization products including furfural, 5-methylfurfural, maltol, isomaltol, cyclotene may give "caramel" or "butterscotch" notes even when each of them is well below its individual sensory thresholds. These additive and cumulative effects are extremely important.

Q Can oak aroma compounds from different "families" have additive or synergistic effects? Yes. Notably, syn-

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ergistic effects between oak lactones and vanillin have been reported by various sources. Oak lactones may increase the perception of vanilla notes, while vanillin may boost coconut aromas.

Q What compounds are responsible for "piney," "resin," or "dill" aromas in oak or wine? Such descriptors, generally associated with American white oak, *Quercus alba*, seem linked to high levels of cis-oak lactone. *Quercus alba* has also been reported to contain relatively high amounts of terpenes. Although terpenes may contribute to these aromatic characters, key compounds have not been identified.

Q What compounds are responsible for a wet concrete/cardboard or "corked" smell in a wine aged in oak or produced with oak chips? Oak is one possible source of haloanisoles contamination in wine. Haloanisoles (TCA, TeCA, PCA, and TBA) are powerful odorants with a musty, moldy, corked smell. ETS offers determination of haloanisoles in wine and oak samples. For more information, check the haloanisoles publications at www.etslabs.com.

Q How does ETS analyze oak aromas? Analysis of wine samples is performed using gas chromatography with detection by mass spectrometry (GC/MS). Solid phase microextraction headspace technology is utilized for sampling (Headspace/SPME). This integrated analytical system allows great specificity and sensitivity. Oak shavings, chips, or cubes are soaked in an unoaked wine and the soak solution is analyzed.

Q What is the reference used for the radar plots included with the ETS reports? Typically, ETS uses the mathematical average of samples submitted together in the same group as a reference when generating radar or "spider" plots. Please contact ETS if radar plots built from another reference are desired, or when submitting a single sample.

Note that radar plots make sense only when comparing very similar samples. Radar plots are great visual aids, but keep in mind that the most valuable information is the actual concentration reported for each aroma compound.

Q What is a representative sample? A sampling plan is very important due to potential variability between barrels. Sources of variation include differences from one piece of oak to another, even from same wood origin, and inconsistent toasting. Individual barrel samples can be used to evaluate barrel-to-barrel variation in the cellar. For most other applications, composite samples from a minimum of four identical barrels are a better choice.

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ETS OAK AROMA ANALYTICAL CAPABILITIES

Aromas from oak ageing are an integral part of many fine wines. Oak species and origin, cooperage practices, and winemaking techniques all influence oak aroma compounds present in a given wine. Analysis of the main aroma components released by oak wood is a key to understanding oak contributions to wine flavor.

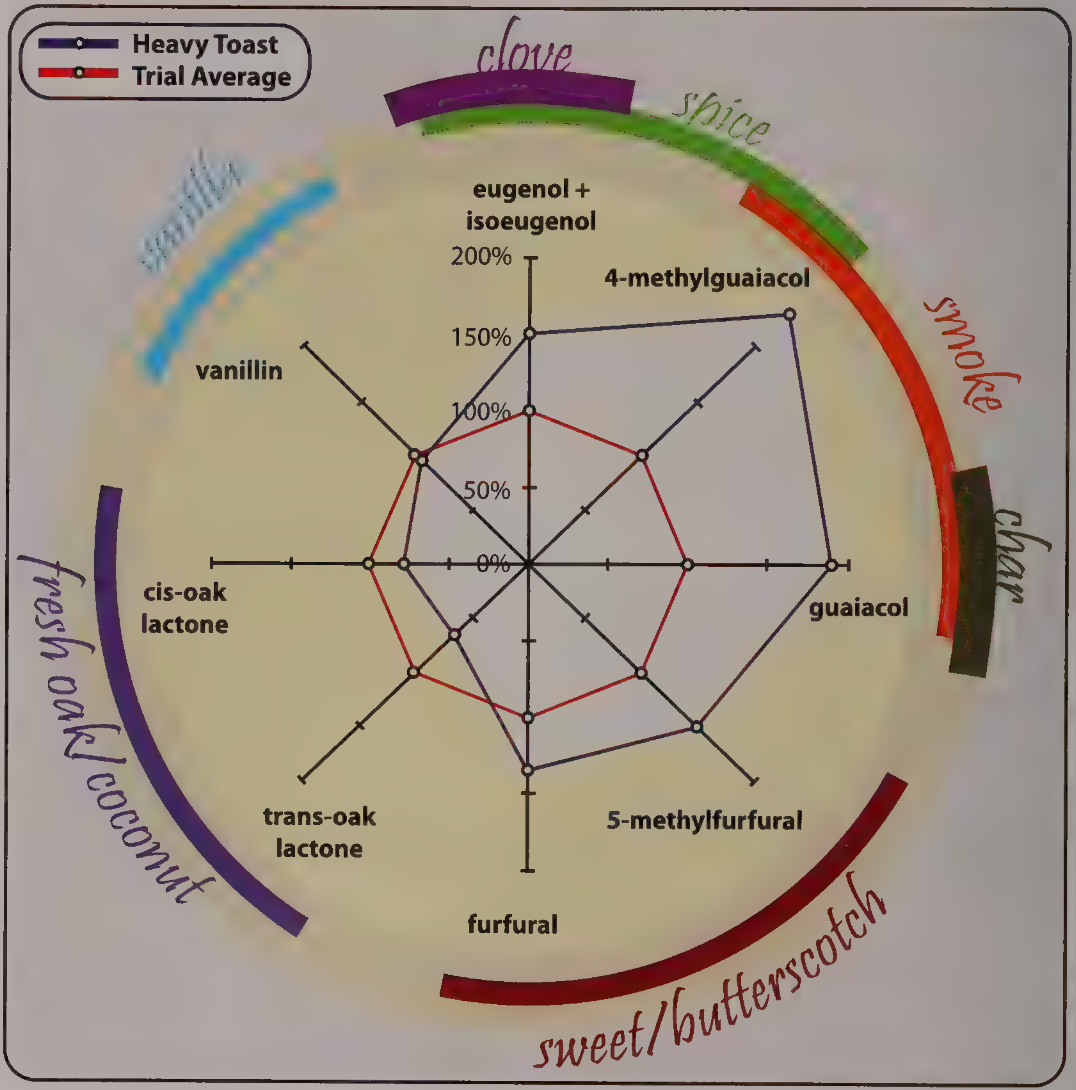
ETS Laboratories offers a tool for analysis of the primary oak aroma compounds found in wine. This panel contains nine compounds representing a broad range of chemical classes and sensory effects. The Oak Aroma Analysis has a broad range of applications in winery barrel management, research, and quality control.

Applications – Wine and spirit samples, and oak material (chips, shavings or cubes) can be submitted for analysis. Oak material is soaked several days in an "oak free" (unoaked) wine and the resulting soak solution is analyzed.

Suggested Applications

- Evaluating barrel trials (wood source, toast level, cooper)
- Monitoring wine ageing in barrel (evaluation of same wine over time)
- Fine tuning barrel management (effects of barrel age or sanitation programs)
- Evaluating or managing barrel

ETS OAK AROMA REPORT: WINE AGED IN "HEAVY TOAST" BARREL



Useful results for alternative oak treatments can be obtained on a bench scale from wine soaks using oak powders, shavings, or chips. Larger oak pieces present more of a challenge. It is often preferable to perform real-size trials in a cellar to evaluate barrel inserts or staves immersed in tanks.

Q How to submit a sample?

Wine Samples

Representative wine samples should be submitted in full tubes or bottles without headspace. The minimum sample size is 60 mL. Glass is recommended to avoid any possible interference from plastic polymers.

Oak Samples

Oak shavings, chips, or cubes should be submitted in sealed bags

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alternatives (staves, chips, beans)

- Comparisons to benchmark or competitor's wines

REPORTING – The ETS Oak Aroma Analysis is reported in concentrations of µg/L (ppb) for each compound.

Concentrations are also displayed in relationship to a reference by means of a "spider" or "radar" plot. The sample concentrations are expressed as a percentage of reference values that are usually result averages obtained for similar samples.

Sensory descriptors associated with reported compounds are indicated on the plots.

OAK AROMA COMPOUNDS

Lactones (*cis* and *trans*)

The main aroma constituents of raw oak are the *cis* and *trans* isomers of oak lactone. Their associated sensory descriptors are fresh oak and coconut. The *cis* isomer is a more powerful aromatic than the *trans* isomer. American white oak (*Quercus alba*) is relatively richer in the *cis* isomer compared to other oak species. Wood seasoning is reported to affect the relative ratios of *cis* and *trans* oak lactones. An increase in barrel toast may reduce the amounts and the sensory impact of oak lactones in wine.

Vanillin

Vanillin, the main aroma compound in natural vanilla, is also present in raw oak. The quantities of vanillin vary with oak species and seasoning. Vanillin increases with medium toast levels, but may decrease with very heavy toast. Vanillin is partially transformed to non-aromatic vanillyl alcohol by yeast during barrel fermentation.

Eugenol and Isoeugenol

Eugenol is the main aroma compound found in cloves. Present in raw oak, eugenol is reported to increase during open-air seasoning of wood. Eugenol and isoeugenol possess a very similar spicy, clove-like aroma. Release into wine is reported to increase with toasting level.

Guaiacol and 4-Methylguaiacol

Wood lignin degradation at very high temperatures (pyrolysis) results in formation of a wide range of volatile phenols including guaiacol and 4-methylguaiacol. These compounds have smoky aromas, and are markers of the smoky character imparted by heavily toasted oak. Guaiacol has a char aroma, while 4-methylguaiacol has both char and spicy characters.

Furfural and 5-Methylfurfural

Furfural and 5-methylfurfural result from caramelization of cellulose and hemicellulose during barrel toasting. They possess sweet, butterscotch, light caramel, and faint almond-like aromas. They may contribute these characteristics to wines aged in oak and are also markers for the whole family of caramelization compounds.

RESEARCH – A Cabernet Sauvignon was aged in barrels with a range of different oak toasting levels. The barrel-aged wines were analyzed at 18 months using the ETS Oak Aroma Analysis. The data is represented graphically, illustrating a wine aged in a French oak, "Heavy Toast" barrel relative to the average levels of all the wines in the trial.

INTERPRETATION – The analytical data clearly indicates chemical differences and potential sensory differences within the barrel trial. The wine aged in "Heavy Toast" barrels displays an overall greater extraction of flavor/aroma compounds than the group average. The amount of oak lactones was relatively low, suggesting less fresh oak and coconut aromas. Vanillin (vanilla) was close to the average. Furfural and 5-methylfurfural (markers for caramelized tones) and eugenol and isoeugenol (markers for clove/spice) were considerably higher than average. Compounds showing the greatest increase were 4-methylguaiacol and guaiacol (markers for smoky character) matching the perceived sensory impression of smoky and charred aromas in this wine.

or containers. Plastic is acceptable for solid samples. Minimum quantity required is 50g.

Q What does ETS recommend for oak origin? toasting level? cooperage? Decisions affecting the qualitative and quantitative oak contribution to a particular wine are discretionary, and are part of the unique art and individual style each winemaker brings to his wine.

The ETS Oak Aroma analysis provides winemakers with a useful production tool that can be used to enhance their efforts to optimize the oak contribution to wine aroma, and help them make sense of sensory data and impressions. It also provides a great educational tool, helping describe complex aromas by breaking them down into their various components. ■

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Sequential inoculation

Continued from page 51

It is this sequential development during alcoholic fermentation of the non-*Saccharomyces* and *Saccharomyces* yeast populations that contributes to the intensity and complexity of the wines. ■

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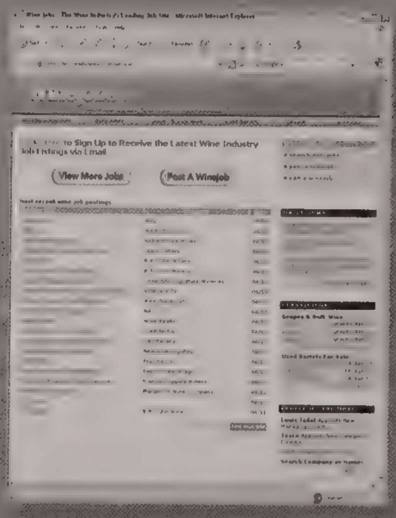

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CARBON FOOTPRINT OF GLASS PACKAGING

BY Jay Scripter,
Vice President of Sustainability, O-I

When calculating the environmental impact of glass, aluminum, plastic, or other packaging materials, it is critically important that the material's entire life cycle be taken into account — from the extraction of raw materials through reuse, recycling, or disposal. While this complete approach to life cycle assessments (LCAs) might seem like common sense, international standards for measuring and reporting carbon footprints are open to interpretation.

There are wide variations in how companies and industries measure carbon footprints. Some studies ignore what happens before the raw materials reach the factory and after they leave (a "gate-to-gate" method).

In instances where raw materials require extensive processing, like extracting and processing petroleum to make plastic pellets for Polyethylene Terephthalate (PET) containers, this can comprise a sizeable portion of the product's complete carbon footprint. For example, extraction and processing of raw material is responsible for more than 50% of a PET wine bottle's carbon emissions.

Other carbon footprint studies disregard what happens after the finished product leaves the manufacturing plant (a "cradle-to-gate" method). The remainder of the product's life cycle — the transportation of finished products to distributors and retailers, use by consumers and reuse, recycling or disposal of the material — are not included.

A "cradle-to-grave" carbon footprint method does not reflect the impact of recycling or reuse. In the example of the PET wine bottle, this type of study does not consider the fact that most PET containers captured for recycling are down-cycled into plastic chairs and clothing, creating a new phase of the product's life cycle. This is in sharp contrast to glass, which can be infinitely recycled into new glass containers, in a process called closed-loop recycling.

Challenge of measuring a carbon footprint

The problem is that these variations in life cycle assessments are not easy to identify. While there is an International Organization for Standardization (ISO) standard that applies to LCAs — ISO 14040 calls for assessment of the complete life cycle — there are no means for enforcing the standard. As a result it is virtually impossible to compare the carbon footprint of one packaging sector with that of another, which has left consumer products companies, retailers, and environmental groups confused and uncertain of what to believe.

Need for clarity

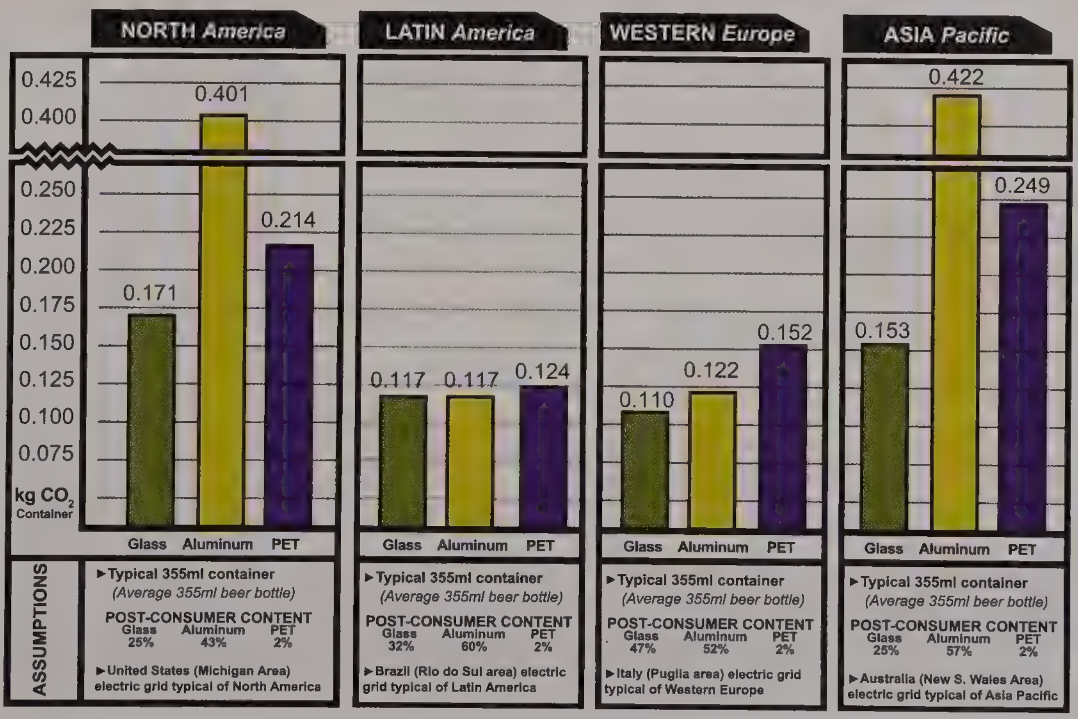
O-I is attempting to be as clear as possible in measuring and reporting its carbon footprint data by taking a complete — or "cradle-to-cradle" view — of the carbon footprint of its glass containers. Only by looking at each and every step of the life cycle of each packaging material can accurate carbon footprint comparisons be made.

The first complete carbon footprint study in the packaging industry, O-I's lifecycle report provides some important new insights into the carbon footprint of glass packaging, including:

- A typical 355-ml (12-oz) glass container — the size of an average beer bottle — generates 0.171 kg of carbon dioxide from the time raw materials are extracted until the glass container is reused or recycled.
- The transportation of finished glass containers contributes only 4% to 5% of glass's complete carbon footprint.
- The reduction in emissions brought about by the use of recycled glass in the production of new glass containers more than offsets emissions resulting from finished goods transportation.

Comparing glass with other packaging materials

To encourage other package-makers to share their complete life cycle



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and a finish of caramel and custa
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information, O-I also calculated the complete carbon footprint of aluminum and PET containers as part of its assessment, using industry and publicly available data. Figure 1 shows the carbon footprints of the most commonly used carbonated beverage container (355 ml or an average 12-oz beer bottle), as measured in kilograms of carbon dioxide. This comparison showed that glass has the most favorable carbon footprint in North America, Europe, and Asia; in Latin America glass and aluminum were equivalent.

Environmental benefits of glass

Glass has many inherent attributes that make it a naturally greener packaging choice. Glass is made from pure, abundant natural resources including sand, limestone, and soda ash. Most of the raw materials are transported to glass bottle producers by rail, the most environmental and economical transport.

Glass is reusable and infinitely recyclable. A refillable glass bottle is typically reused 20 to 30 times. Refillable bottles are widely used in Latin America, Western Europe, Canada, and Mexico. Reusing one bottle at this rate could cut its carbon footprint from 0.117 kg of carbon dioxide to as low as 0.006 kg.

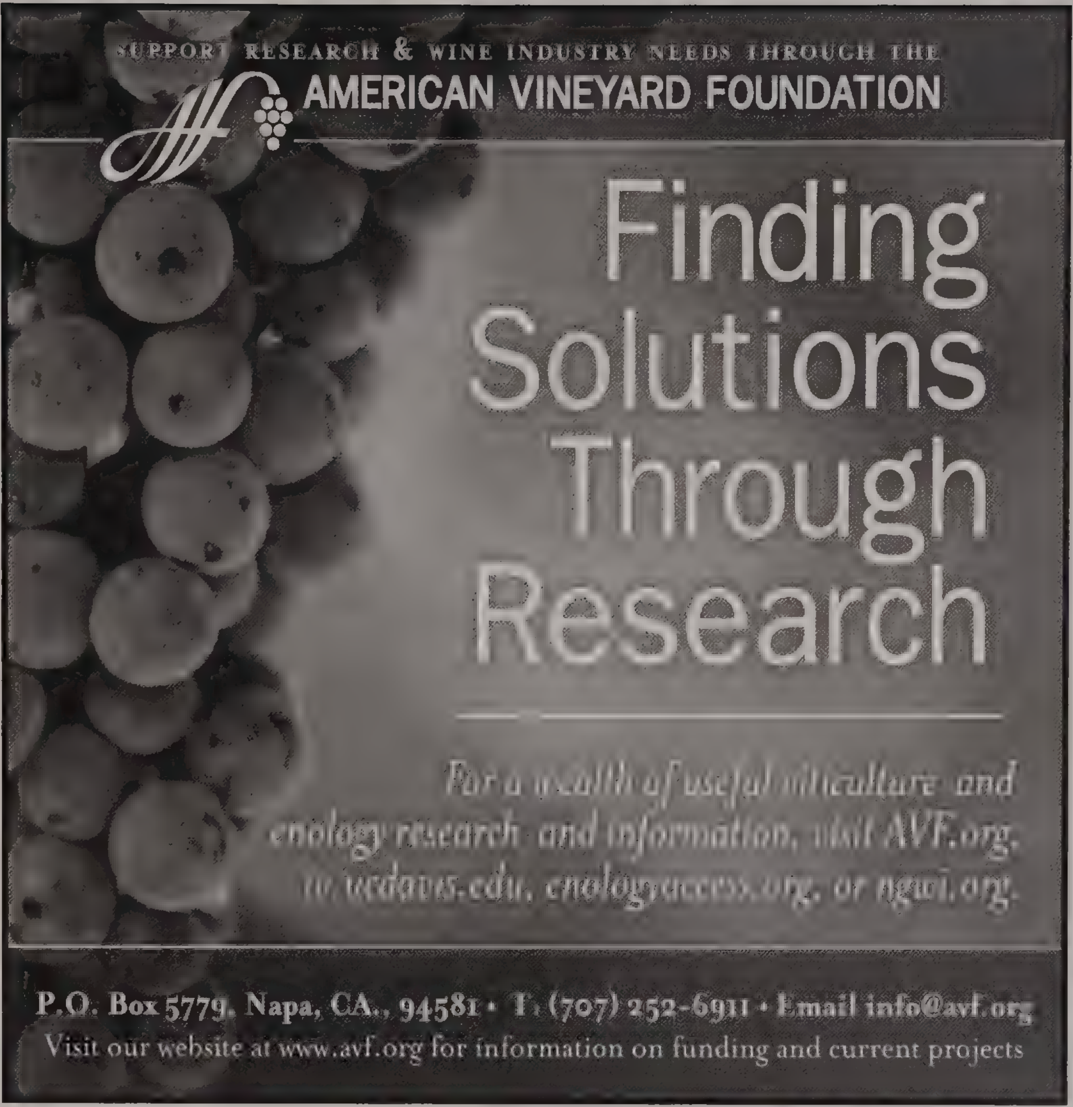
Each year O-I uses nearly five million tons of used glass to make new bottles and jars, making O-I the world's largest user of post-consumer glass. On average, each O-I glass container is made up of 36% recycled content. In Europe, recycled content can be significantly higher — reaching up to 90% — due to the region's robust and successful recycling programs.

In addition to reducing landfill waste, recycling glass yields immediate energy and carbon emissions savings. Every 10% of recycled glass used in production results in an approximately 5% reduction in carbon emissions and energy savings of about 3%.

Model for all packaging materials

While O-I encourages all other manufacturers of packaging materials to adopt the complete life cycle method, we will use the data from our own study to track our progress in reducing our environmental impact through the next decade. Meanwhile, O-I is investing heavily in its R&D capabilities and is actively engaged in research aiming to improve processes and products to reduce the environmental impact of glass. Our research is yielding lighter weight containers and significant reductions in energy usage. ■

Jay Scripter is O-I's vice president of sustainability, responsible for shaping the company's sustainability priorities and developing strategies and processes aimed at improving O-I's position as a sustainable company. He leads the global corporate safety team and directs projects that focus on key opportunities in the areas of energy, environmental compliance, recycling, and related issues.



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— VARIETAL REVIEW —

CHATEAU GRAND TRAVERSE

MEET A FOCUSED RIESLING LEADER

BY Eleanor & Ray Heald, Contributing Editors

Over the last few years, one of the most talked about wine trends is the market growth of Riesling. Together with Chardonnay and Sauvignon Blanc, Riesling is typically included in the top three white wine varieties. With good reason: A recent report in *New World Wine* cited Riesling as the fastest growing sector in the U.S. wine market.

Riesling's overall character is influenced by place of origin, including colder regions such as northern Michigan and especially the Old Mission Peninsula (OMP) American Viticultural Area (AVA), home to Chateau Grand Traverse (CGT).

Paramount to attaining high quality Riesling are hillside vineyards within cool microclimates, abundant sun exposure, and protection from wind. The best German vineyards with these conditions on the Mosel River produce wines that are unique in their low alcohol, dominant aroma, and high extract.

A U.S. producer meeting these criteria is Chateau Grand Traverse which bottles seven Riesling styles, from dry and crisp to unctuous dessert nectars from *Botrytis cinerea*-infected, individually late-picked shriveled berries. The focus here, however, is the dry style.

About one-third of Michigan's 73 wineries produce Riesling from vines that are cold weather tolerant. Budding late, they are perfectly suited to Old Mission Peninsula, yielding 2.5 to 5 tons per acre (TPA), depending on vine age.

As one of 30 prominent international Riesling producers who formed the International Riesling Foundation (IRF), the O'Keefe Family (CGT owner) is helping lead the world to drink more Riesling. The IRF is responsible for creating a standard Riesling Taste Profile for labels to make it easier for consumers to predict the flavor they can expect from a particular bottle of Riesling.

To aid winemakers in using consumer-friendly terminology for Riesling labels, the IRF developed a technical parameters chart, citing the interplay among sugar, acid, and pH determining the probable taste profile of wines labeled from dry to sweet. (*PWV* Nov-Dec 2008 "Consumer research leads to Riesling Taste Profile").

Since 2008, all CGT Riesling bottlings have the IRF scale on back labels.

Planting began in 1974

CGT was founded in 1974, the year it planted a 4-acre trial block of more than 40 vinifera white and red varieties. In 1976, CGT planted 12 acres of Riesling Clone 90 and 8 acres of Clone 239 under direction of the late Dr. Helmut Becker of The Geisenheim Grape Breeding Institute, Germany. Clone 239 was the first commercial U.S. planting and the CGT 20-acre planting was the first commercial commitment to the variety in Michigan.

Riesling on a pendelbogen trellis.

Over the years, additional Riesling plantings to a total of 94 acres in 34 blocks make CGT the largest Riesling vineyard in Michigan and the largest Riesling producer east of the Mississippi River. From the first planting, Riesling was the main focus and remains so today.

Some of the original 1976 Riesling plantings have been replaced with Clone 90. Replants filled in missing vines that died over the years. CGT is reluctant to rip out any vineyards because they are still producing well. Based on the fact that in the Mosel, Riesling vines can produce well for 60 to 80 years, the belief is that CGT has many years to go with the original plantings.

For the original planting adjacent to the winery, land was recontoured to create better air flow. "In doing this," admits Sean O'Keefe, winemaker/vineyard manager for CGT and son of founder Ed O'Keefe II, "we did disturb the soil structure and it will take my lifetime of compost and manure applications, mulch and cover crops to bring the topsoil into better balance with more organic material. Recontouring brought up the underlying lime subsoil, so we have a site that

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Because of glacier impact in ages past, Old Mission Peninsula is a moraine of sand and gravel, thus there was not significant organic material when the vines were planted.

Rootstock

Planting in 1974 included several rootstocks; predominantly 3309 and SO4 with some 5BB and 5C. "Now," O'Keefe explains, "a lot of these vines are own-rooted because SO4 has a reputation of declining after 20 years. Because we have such sandy soils, soil grape phylloxera should not be a major risk, and leaves me wondering why we continue to plant exclusively on grafted rootstock in northern Michigan, especially for replants and in colder areas where winter damage is more of a threat.

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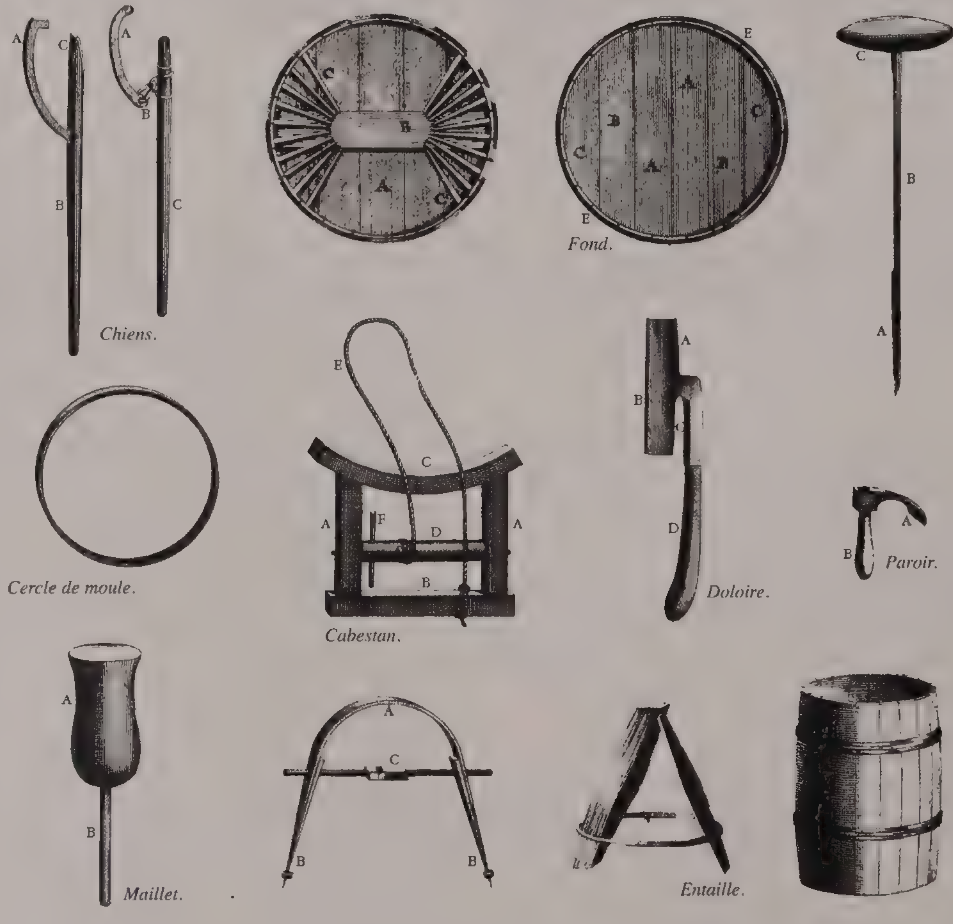

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"All research indicates that phylloxera can not survive in sandy soils. Washington State vintners have moved in the direction of own-rooted vines, and we are considering research in that direction.

"The reason that 3309 and 101-14 are popular rootstocks today, is that they have the reputation of promoting early maturation and with that comes early wood ripening, which is important in a cold winter region such as Old Mission Peninsula. The big research question is: will own-rooted vines harden sufficiently to survive northern Michigan's winter conditions?"

Irrigation

About 65% of CGT vineyard blocks have drip irrigation. In the first three to four years after planting, it was used to establish vines. Yet, with summers quite dry, it is used now to keep vines healthy, but not so much that vines become dependent on it. CGT maintains permanent grass cover between vine rows in order to prevent erosion and soil compaction, but they also compete for water which can be problem in a dry growing season.

"Because of the relatively late starting growing season," O'Keefe explains, "We irrigate in May and June to give the vines a good start. Soil moisture sensors are used to monitor the soil and water stations indicate the transevaporation rate. Instrumentation is helpful, yet there is no substitute for walking through the vineyard and observing vines. We have also experimented with mulch and compost to build organic material and retain soil moisture.

"In replanting, irrigation is a huge cost. It is not simply having a well, it is the drip-hose, suspension wire, and more. Early on, we believed that going cheap with materials that would last five to six years was the way to go. I think differently today because I recognize that despite all the water surrounding us, we live in a very dry, drought-prone region. I would also like to have the option to use drip irrigation for fertigation and possibly apply compost tea.

"Near veraison and due to our sandy soils, nutrients are being pulled into the grapes, and yellowing of the leaves often occurs. Putting a small amount of an appropriate nitrogen compound in the soil through drip irrigation is beneficial."

Typical fertilizing regime in northern Michigan is an inorganic fertilizer application in the Spring. CGT applies some inorganic fertilizer if needed, but is converting to high nitrogen compost from a local compost farm. Vines take up some, but the rest gets washed through the soil and has the potential to end up in aquifers, or Grand Traverse Bay. Ideally, O'Keefe would like to use only compost and manure and build up the soils. Inorganic fertilizers are only stopgap measures. "Our emphasis is on soil building through compost, mulch, and cover crops," explains O'Keefe. "We hope to eliminate all inorganic fertilizers by 2012."

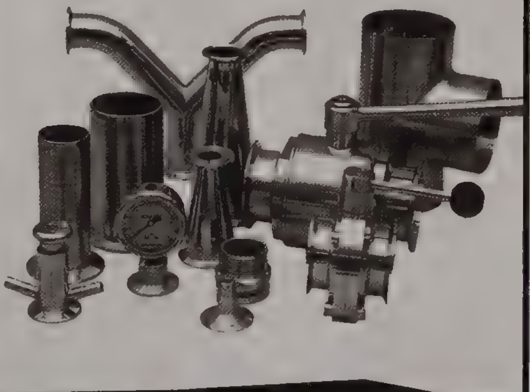
Grand Traverse Bay impact

CGT is on the edge of grapegrowing potential in the northwest sector of Michigan's lower peninsula. "Yet, that is right where I want to be since Grand Traverse Bay impacts our vineyards' personality," adds O'Keefe.

As the ice age glaciers receded, they dug two very deep bays on either side of the Old Michigan Peninsula, which is only two miles at its widest part and 18 miles long. Vines stay dormant longer (bud break is typically in mid-May), which protects the vines from late spring frost. CGT's location on the 45th Parallel makes up for that with extended hours of sunlight that results in rapid vegetative growth in June and July.

By veraison, vineyards have caught up to other wine regions in the northern hemisphere. That is where Grand Traverse Bay helps, because the bay does not gain or lose heat as fast as land. The region remains warmer in autumn, with daytime temperatures in the 60s (°F), dropping down to the 40s at night. Frost conditions do not occur until November. From veraison to harvest, CGT has as long a season as the prominent Riesling regions of Germany.

Riesling grows well in these conditions. If the temperature drops to 35°F at night, but warms into the 50s during the day, Riesling starts photosynthesizing again. "Under the same conditions as an example," O'Keefe emphasizes, "Cabernet Franc gets shocked and takes significantly warmer daytime temperatures to continue ripening. When an OMP autumn is colder than normal, Cabernet Franc does not ripen, but Riesling plugs along until all leaves have dropped."



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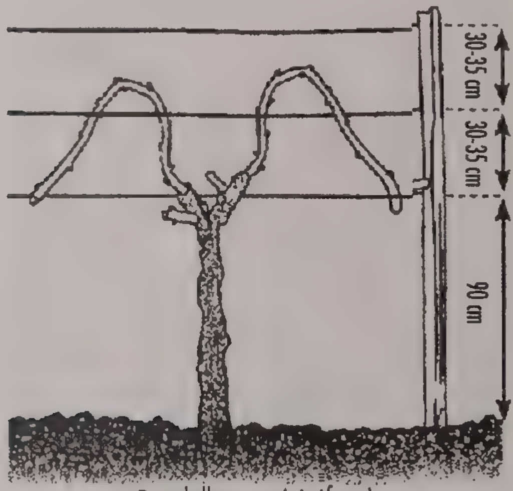
Soil composition

O'Keefe describes CGT soil as sandy glacial till mixed with gravel and clay spots. "*Terroir* is often misconceived as being all positive," he says. "But *terroir* just is. It has elements both positive and negative that a vintner works around and with. Clay, alluvial, or volcanic soils yield wines with a richer mid-palate and often can be more peachy aromatic. Sandy soils tend toward lighter bodied, more delicate wines that focus more on the fine interplay of acids and sugar. The wines are not overtly showy, but they are structured very taut.

"Northern Michigan Riesling vines survive better in extreme conditions than regions where soils have a higher clay content. When temperature drops to zero, -10°F, or lower without insulating snow cover, water content of clay soil freezes roots and kills vines. Sandy soils are better drained (and warm more rapidly). Northern Michigan's lake effect snow offers good vineyard insulation."



Pendelbogen (vinifera)

Vine training and trellis

The trellising is vertical shoot positioning with a moveable wire system. The fruiting wire is 2.5 feet above ground. Tractor rows are typically 9-feet wide with 4.5 feet between vines.

CGT Riesling is pendelbogen-trained. From German, pendelbogen translates as pendulum bow, the name for an arched-cane training system. Typically, a 50 cm (20 inch) height difference between the cane end and highest point is believed to improve budbreak mid-cane.

Shoots are trained vertically between foliage wires and normally require top trimming. "Pendelbogen," O'Keefe explains, "improves ripening over the entire canopy. There is better sap flow and even ripening. Because it is an arched cane rather than straight, there is more cane per square area with the potential of more viable shoots."

Yields for vineyards over 20 years old average 2.5 to 3.5 TPA and younger vines average 4 to 5 TPA.

An annual production of 80,000 cases of Riesling includes 3,000 to 4,000 cases, dry style.

Harvest parameters

Independent of numbers representing sugar and acid, CGT monitors sugar accumulation, drop in acidity, and overall grape flavors to judge when to pick. Decisions depend significantly on temperature. "It is always a race to the finish," O'Keefe contends. "If we get a frost too early, leaves fall and we have to pick."

Typically, Riesling is harvested between 18° and 22.5° Brix. In a cooler year, pH is 2.9 yet can reach 3.3 in a warm year like 2007. Rain is the critical factor during harvest since it causes a dramatic drop in Riesling acid levels. If it is warm at the same time as a rain event, acid can drop by 2 or 3 g/L in one day.

"Because it has less sugar," O'Keefe continues, "the dry Riesling must have the most flavor and balanced acid. It is not our most popular selling wine – the sweeter wines are. But this is a wine that we love to make, and one that must impress consumers on the very first sip."

"Thus the Brix, pH, and TA must be the correct parameters (between 19° and 21.5° Brix), but it must be flavorful without a malic acid backbite. This is site-specific and varies vintage to vintage. We do not make the dry style from the same blocks every year."

Preferred TA is 9 g/L and CGT picks based on acidity. "We do not like to mess around with acid," stresses O'Keefe, "whether it is adding or deacidifying, because it destroys the wine's structure. In a poor year, I would rather chaptalize because it is a lot more neutral."

Eighty percent of CGT Riesling is mechanically harvested in cool conditions. Since estate vineyards are adjacent to the winery, there are no extraction issues before the grapes arrive at the press pad. A lot of the time, Riesling whole clusters drop onto the harvest-conveyor, but in a less ripe year, the berries get shaken off.

"Because of our large Riesling acreage," explains O'Keefe, "picking is done over a range of days, yet that offers opportunity to exit fermentation with wines that are slightly more tart with lemon, lime, green apple, and nervy flavors. The last picked grapes are richer with peach and apricot characters."

All vineyards up to about five to six years old are hand-picked. O'Keefe also makes whole cluster specialty wines in a dry style, especially from younger blocks. This avoids any green characters on the palate.

In a warmer year like 2007, skin contact is important for unique flavors and middle body that are not there in a cooler year. Warmer year grapes are either destemmed and cold soaked (at less than 50°F) for one to two hours or longer.

Cellar techniques

Three membrane presses (3-ton, 9-ton, and 20-ton capacities) are employed at a maximum pressure of 2 bar. On average, juice yields are 170 to 175 gal/ton; yet this varies with vintage ripeness.

Because it strikes a nice balance between highlighting fruity aromas without creating banana characters, O'Keefe prefers cultured Steinberg yeast. Prise de Mousse is also used as a neutral yeast and steady fermentor. "We have experimented with the newer South African yeasts such as Bin 13 and Bin 7," he adds. "A range of yeasts gives us a spice box.

"There are many yeast cultures promising aromatic enhancement. I have used them and learned that none of the so-called enhanced aromas or flavors last beyond six months in the bottle. After that, every wine converts back to type.

"Three years ago we invested in 1,200- and 2,400-liter neutral oak barrels from Germany, in which we are experimenting with uninoculated fermentations for very ripe Riesling."

Peak fermentation tank temperature ranges from 52°F to 65°F. To achieve a longer fermentation of six to eight weeks, temperatures are not allowed to go higher in the initial yeast reproduction stage.

The wine does not go through malolactic fermentation. An addition of 50 to 80 ppm SO_2 is made after primary fermentation. At bottling, SO_2 measures 35 ppm free and 80 ppm total.

First racking off gross lees occurs in late December or early January. A second racking follows in two to four months. For wines intended for release in late Spring following harvest, bentonite is added to some lots after juice settling to aid early settling. Otherwise, no fining is done. Filtration sequence begins with DE, then one large-pore pad filtration, and sterile filtration at bottling in early June with release by the end of the month.

Challenges/Rewards

Achieving even ripening remains a CGT challenge. "Because Riesling skins ripen unevenly," notes O'Keefe, "achieving ripe (tartaric) acidity that is more mature, not bracing or sharp, but rounded, remains a challenge. Riesling is not a difficult grape to grow at CGT. We are making very good wine, but still tweaking things to attempt to produce great wine.

"On the flip side, is the advantage of making many different wine styles from one grape variety. Of all the styles, dry Riesling is most reflective of vineyard origin. With dry Riesling there are less tricks that can be used. In sweeter styles, sugar hides flaws. The best dry Riesling rides the line where there is just a little sweetness, but with a nice ripe acidity.

"However, I believe that bone dry is not the answer to increasing Riesling popularity. With the high acids of OMP Rieslings, residual sugar in the range of 12 to 16 g/L make a pleasant wine. The CGT dry Riesling has 6 g/L RS. Our most popular Riesling has 4% to 4.5% RS. When Riesling is completely bone dry like Australian Riesling, it reminds me of drinking a gin and tonic."

The dry Riesling is a blend of wine lots stopped by chilling and SO_2 addition. The largest volume Riesling is a blend of wine lots stopped and additions of Suss Reserve to achieve 4% to 4.5% RS.

The level of dissolved CO_2 in CGT Rieslings is natural. "We do not adjust it at bottling besides fiddling with the back pressure on the filler to control foaming," says O'Keefe. "The whole cluster Riesling tends to retain more CO_2 because it is both racked and filtered less, and tends to be bottled colder than other bottlings."

O'Keefe cites an interesting sales phenomenon. Although Michigan is CGT's largest sales market, its

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Dry Riesling is more popular outside the state. Los Angeles, California, and New York City are big markets because there, consumers are generally more familiar with European wine styles and dry is the choice. In the mid-west, Ohio and Indiana are good markets.

"Because," O'Keefe notes, "we sell out of Riesling with increasing sales within Michigan, most of our out-of-state distribution is focused on higher end wines meant to build our nationwide reputation as a top Riesling producer."

Ageability

Although, ageability is vintage-dependent, O'Keefe dubs dry Riesling as "a strange wine. To be interesting beyond 10 years, a truly ageable Riesling needs a small amount of residual sugar. Therefore, a semi-dry Riesling has typically more ageing potential than a dry.

"I do not want the petrol character of Riesling to form too quickly. Yet, sandy soils tend to form petrol characters earlier than wines from other soils. American consumers tend not to like a petrol character. But it forms in a dry CGT Riesling within two to three years and retains a fruity component up to four to five years."

Riesling zealots and appellation difference

PACIFIC RIM WINERY and JANA WINES

Pacific Rim Winery (West Richland, WA) has earned the moniker "Riesling zealots." Winemaker Nicolas Quillé discusses his perception of the regional appellation difference between Michigan dry Riesling and those from Columbia Valley, WA.

"Columbia Valley AVA is a warmer climate. Therefore Riesling has more phenolic content which contributes structure. At Pacific Rim, 0.8% residual sugar remains in the wine. Some WA producers leave 1.0 and 1.1% and still call it dry, but I do not consider that level to be dry.

"CO_2 definitely participates in the perceived acidity of a wine and it is important to keep that in mind when looking at the overall balance of a Riesling. We never have to add carbon dioxide because our CO_2 levels are high on tank-aged Rieslings. It is normal to have CO_2 around 2,200 mg/L right before bottling. We actually often have to sparge out some dissolved CO_2. We target about 1,500 mg/L in our Dry Riesling in most vintages.

"From a flavor profile perspective, Washington Rieslings are somewhat riper with more peach and apricot rather than the citrus notes found in Michigan dry Riesling."

When asked which factor among soil, aspect, clone, rootstock, or overall climate is most important in determining regional style, Quillé replys, "The most important factor is to get the winemak-

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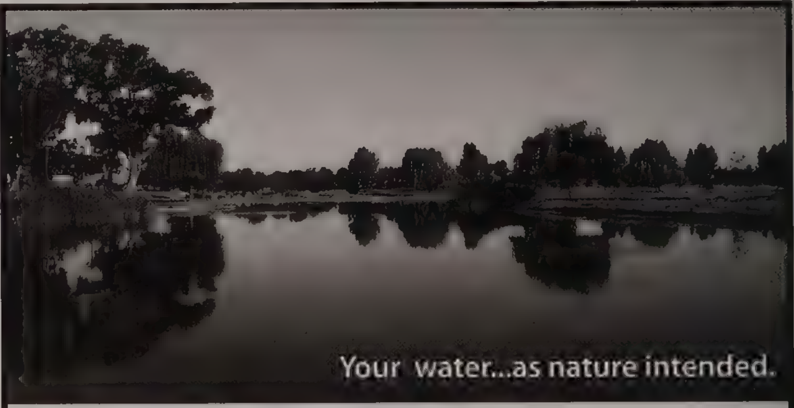

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ers together to agree on a regional style.

"When there is an emerging region such as Michigan or Washington state, there are so many different microclimates and winemakers that styles are all over the board. Also, with Riesling, there are so many possibilities with sugar and acid levels that it takes time to define a regional style."

Scott Harvey, proprietor/winemaker of Scott Harvey and Jana Wines (St. Helena, CA) has made Dry Riesling from northern Michigan grapes. He describes the regional appellation difference between Michigan and the Napa Valley fruit he sources for his Napa Valley Riesling bottling: "The difference is warm and cool climate. They both produce interesting and fun wines, but have a completely different makeup.

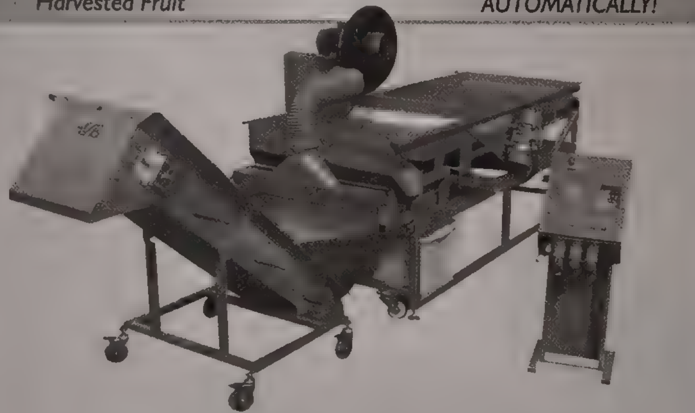
"At low sugars (17.5° to 18° Brix) in Napa Valley's warm climate, harvest is in early August. I obtain mature Riesling flavors early on. Maturity development is very quick. Berries can be hard and unripe, but within a week yellowing is visible, berries soften, and they develop mature flavors.

"Most California winemakers do not know that. They let Riesling hang until 22° to 23° Brix and the acidity is lost and grapes are too ripe for attractive Riesling. I make a Riesling at 9.5% alcohol from a warm-climate, yet the wine has cool climate character.

Jana

"When I make Riesling from either northern Michigan or the New York Finger Lakes AVA, these colder climates do not allow the same ripeness progression. At 18° Brix, there is evidence of ripening, but it takes three weeks or more to develop flavor of ripe peach that I am looking for.

"That is why the flavors of a Michigan Riesling like CGT are much more European and complete. Alcohol will reach 11% with balanced acidity. With Napa Valley fruit at 17.5° Brix, I need to add acid to achieve balance.



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Being German-trained, I am a cold climate Riesling guy."

Harvey also bottles a Mendocino County Dry Riesling. "It is much colder there than Napa Valley," Harvey stresses, "but it is nowhere near Michigan. Mendocino Riesling ripens at 17.5° to 18° Brix, but that is three to four weeks after Napa. It makes a flavorful, more delicate, complex wine than the Napa. But my Michigan wine style is ideal with a clean, ripe but not over-ripe character that is subtle. It is a complete wine with some stone fruit qualities."

Last drop

Riesling has always been dubbed a most versatile wine with a wide variety of foods. Doug Frost (MW, MS, and Founder/Director of the Jefferson Cup Invitational Wine Competition), discusses which foods/food styles pair best with Michigan dry Riesling.

"In general, Michigan dry Riesling is very delicate and while a lot of restaurant professionals talk about how amazing Riesling is with food, I believe that we are talking about Riesling that has a touch of residual sugar. An ideal match is spicy foods and many Asian foods that have some sweetness or are sweet/sour.

"Despite Michigan dry Riesling's delicacy, it has abundant acidity, which is a structuring element, providing some muscle in the mouth, but it does so in a way that does not overwhelm food. It inserts itself in the food and becomes part of the dish.

"Slam dunks with Michigan dry Riesling are shellfish, raw fish (sushi and sashimi), relatively mild dishes, and vegetarian dishes, such as eggplant, tomato, and squash. Surprising also are the match with corn and root vegetables.

"Then there is a food intensity issue. A chef must back off from intense flavors in pairing foods with these wines. Intense flavors will knock a Michigan dry Riesling right out of the park. Single food elements – sweetness, fat, or saltiness can be overwhelming in a match.

"It is most important, though, to pay attention to the delicacy of Michigan dry Riesling." ■

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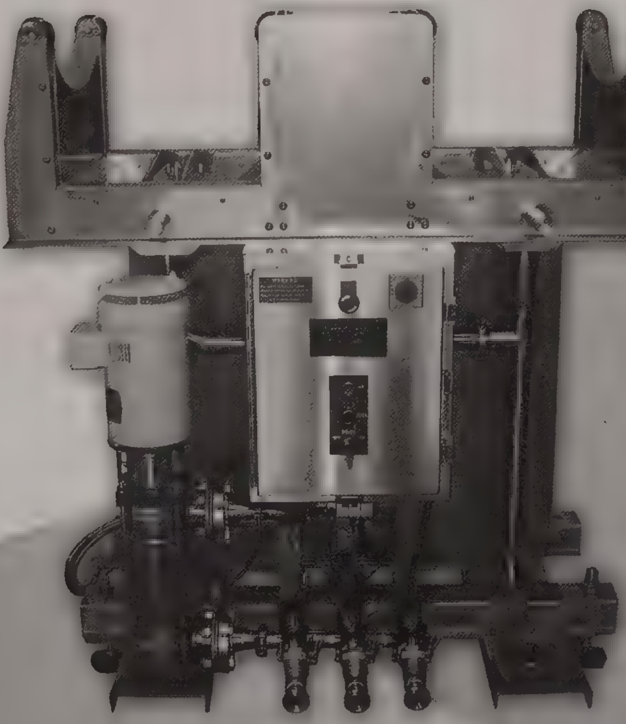

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GRAPE / WINE MARKETING WITH NEW MEDIA AND RETURN OF THE BOOMER

BY Bill Leigon, President,
Hahn Family Wines, Soledad, CA

Today, wineries and growers need to constantly re-invent themselves to adapt to economic and demographic changes that have caused a fundamental shift in the wine industry. We have seen changes in our target consumers, their motivation to buy our wine, and their ability to afford to buy it.

Here, I am going to share my thoughts on current and future market trends, what grapes to plant and what not to plant; and how to use social media, the Internet, and smartphones to help build a brand that can succeed.

Marketing to Millenials

With the success of the Rex Goliath wine brand that we created at Hahn Family Wines in 2002, I stumbled upon the power of the Millennials. I became further entranced with this demographic when I had our marketing department focus on social media. While other wineries often get the credit, I actually appointed the first social media director in the wine business. I did not know what it was called then, so I called it Director of New Media Marketing.

This text was adapted from the Keynote Address at the 2010 Wine Industry Financial Symposium (Napa, CA), September 21, 2010.

By 2005 I, like many of my colleagues, was convinced that the Millennials were now driving the train. The reports seemed to indicate that their buying habits mirrored those of the Boomers. They had spendable income (from somewhere), they regularly bought $10 bottles of wine; spent $25+ on special occasions, were interested in new and innovative ideas, liked innovative labeling and packaging, and, significantly, seemed to view wine the way my generation viewed cars — imported is better.

Rex Goliath was perfect — the absolute right product at the right time. I knew I had a hit because all of my distributors universally hated it. The name was exotic-sounding, Latin-based so we Texans could pronounce it, and the label sported a giant rooster. Once you saw it; you never forgot it. I created the package to look vaguely European so it was not readily apparent it was a California wine.

As we were about to launch I heard about the Yellow Tail brand. At the last moment, I positioned against them, putting boxing gloves on Rex Goliath and creating shelf-talkers with Rex punching out a Wallaby. Rex was and is uniquely American — Red, White, and Blue. His personality is "I'm mad as hell and I'm not going to take it anymore." No matter what the wine pundits and writers say, California can make great wines for $10 per bottle. More on that later.

After the sale of the Rex Goliath brand to Constellation Wines in 2005, I launched the new Cycles Gladiator brand, with another beautiful whim-

Texas-born Bill Leigon has 37 years of experience in the wine industry. He was co-owner of a wine retail store in New York City, National Sales Manager for J. Lohr Winery (San Jose, CA), a co-founder of The Wine Trust and of Ariel Vineyards, and Vice President of Sales & Marketing for Associated Vintage Group. He is now president of Hahn Family Wines, Inc. (Soledad, CA), owned by Nicky and Gaby Hahn and currently undergoing the generational transfer to their children, Philip and Caroline.

Hahn owns about 1,400 acres in Monterey County, including 650 acres planted in the Santa Lucia Highlands. Hahn sells about 140,000 cases/year and 180,000 cases/year of Cycles Gladiator (California appellation). Estate wines include: Hahn Santa Lucia Highlands Chardonnay, Pinot Gris, Pinot Noir, Syrah, and Lucienne Doctor's Vineyard and Lone Oak Vineyard Pinot Noir. Another 80,000 cases/year includes Smith & Hook Cabernet Sauvignon (12,000 cases), Huntington Wine Cellars (40,000 cases), Copa Del Rey (Chile), Lucienne, and private label.

Bill has a unique perspective as president of an organization that operates both as a grower and as a winery, typically selling about as many tons of grapes as they buy each year. He is happy to share that perspective with others in the industry.

sical label. It was another instant hit. Clearly it seemed to me that this Millennial thing had "legs."

Return of the Boomer

Then Lehman Brothers declared bankruptcy on September 15, 2008. This began the total meltdown of the financial markets, with many of the world stock exchanges experiencing their worst losses in history on October 24, 2008. I had been through four industry downturns before; including 9/11. I was convinced Cycles sales would benefit from trading down, and I was worried about our more expensive Hahn wines.

But this "downturn" was decidedly different. Everyone was affected. I don't care how rich you were. A psychic shift occurred. Cycles sales stalled out, then started to decline. The way I described what happened to my owners of Hahn Family Wines is best depicted in the following scenarios, and most importantly in the values these images project:

Pre-September 2008 – "The Roaring Twenties"– Conspicuous consumption is the norm. There is money to be made; easy money. Bernie Madoff is a hero, everybody wants to be like him, contributing to philanthropies.

The sky is the limit: "Let's party like it's 1999." In fact, it was 1999 when the party started to really take off, with deregulation of the banks, etc. Consumers expected at least a 14% to 15% return on stock investments; many of my friends expected more like a 20% to 25% return or they were not happy.

Post-September 2008 – "The Great Depression" – Maybe not bread lines, but massive unemployment; Conspicuous consumption is out! Authenticity is everything. Bernie Madoff goes to jail; nobody wants to be like him. A 4% to 6% return on your investment feels very good. Just not bleeding money anymore feels good.

I believe this psychic shift has had a profound effect on all consumers, and therefore on the way we now need to market our wines.

I ask the question: *Who has the money to buy my wine?* I heard an intriguing report on National Public Radio and researched it. We are now ten years into the largest generational transfer of wealth in U.S. history. Between roughly 2000 and the year 2050 a minimum of $41 trillion will pass from one generation to the next. (I am thinking my Millennial children are never going to see any of my share of that — I am going to the Bahamas.) Even after the financial meltdown, economists still came up with between $40.4 trillion and $65.3 trillion.

Unemployment remains high and is going to remain high for some time, but it is not divided up equally. In fact, as stated in Rob McMillan's *Silicon Valley Bank 2010 State of the Industry Report*, "The latest data show 16% unemployment for Millennials, 9% for Gen-Xer's and only 7% for Boomers."

Another report, from the Luminosity Marketing Study of "Boomerangers" (ages 20 to 29, many of whom moved back home) estimates Millennial unemployment at 37%. Who has the money now to buy my wine?

By coincidence my family seems to represent the perfect snapshot of American life. This fortuitous happenstance has been a major benefit to me throughout my career. My mother is 87 – part of the "Greatest Generation." I am a "Boomer." My daughter is 34 (Gen-X); my oldest son, 28 (leading edge of Millennials); my youngest son, 16 (the latter part

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of the Millennials).

My daughter is a CPA hired directly out of college by Arthur Andersen Company in October 1999, wanting security. She was wooed directly out of college by several companies. Companies were touting in-office massages on Fridays, child care, and unbelievable, countless bennies. Arthur Andersen won. But so much for the security of a large company — she was one of the last ones to turn out the lights in the San Francisco office in 2002.

My oldest son recently graduated from UC Davis with a degree in Viticulture and Enology. This is his second degree; he received a Bachelor of Science at UC Santa Barbara. After graduation, it took him one year to find a job. No one wooed him. No massages. Many of his friends are still unemployed or employed part-time — "under-employed" is the term. They are just thankful to get a job. If they can make 6% return on investment in their retirement accounts – hallelujah!

My youngest son has no clue what is going on. He got me to buy him a new $500 bicycle. His general state of oblivion really got me thinking. Depending on how you determine it, the last Millennial to turn legal drinking age will do so in the year 2021. Today about half the Millennials can't drink, at least not legally, and the older half is suffering massive unemployment.

It is true that the Millennials did not have any retirement savings to lose like the Boomers; but that also means they do not have any retirement savings to recover. I have gained back most of my retirement savings, though it seems to come and go these days pretty quickly.

I used to believe that we were undergoing an overarching 10-year shift; To quote Silicon Valley Bank again, "They [the Millennials] are unlikely to matter as much as the Boomers and gen-Ex-ers when purchasing luxury wines ... probably for the next decade." I now believe we are more likely in a 30+-year shift.

My youngest has no clue about recessions, mortgages, etc. He is largely unaffected. In 10 years, he'll be 26 years old; in 20 years, he'll be 36 years old. It is going to take 20 years before that segment of the population that was not traumatized by the meltdown gets to the prime demographic for wine consumers, 30 years before they are at peak earning potential.

While we should not forget or ignore the Millennials right now, we had better be primarily focused again on the Boomers, at least for another decade. With this group, authenticity is everything. They have been conned; they are jaded; and they no longer believe modern advertising.

For this reason, I have changed our wine label designs to classic style. I actually had started the trend before the meltdown. It seemed to me there were just too many "3 Blind Moose" out there.

Within this 10- to 30-year arc, however, trends still change on a dime. It has always been that way through my career, but technology has accelerated everything. Now, an event occurs and "boom" — it is all over the Internet. Now, I get a call in the afternoon and a customer will say, "Did you read my email yet? I need an answer right away." When did you send it? "This morning."

Chasing trends and taking the right price

Too often we are all chasing the next trend. What do we plant? What is the next "hot" variety? Wow, Moscato sales were on fire in summer 2010. Turrentine Wine Brokerage cannot find enough supply. Let's plant Muscat. Better yet, let's graft over to Muscat in Spring 2011. I am seeing Gruener Veltliner on every restaurant wine list these days; I am sure we can hang 8 tons per acre of that stuff.

Maybe you can, but can you make any money? For those who are trying to guess the next trend, my advice is not to bother. You cannot do it.

Far more important is that when you see the trend developing, move on it. But first you need to ask yourself, *"Does this fit my vision of our brand?" "What is my reason for my brand existing?"* With my grower hat on, "Can I make any money on this variety, long-term?"

This is why understanding the market and accepting its reality is so critical. I believe the hardest decision to make in the wine business is to recognize your mistake and cut your losses — immediately.

> "The hardest decision to make in the wine business is to recognize your mistake and cut your losses — immediately."

There are good and compelling reasons for why this decision is so tough. The bank wants to see a profit. We all want to make a profit. Our loans are dependent upon it. How many times have I been in meetings and heard, "Well, I have $8 per gallon in this wine, I cannot sell it for $6." Then six months later in another meeting, "Well, I have $9.50 per gallon in this wine (it accrues $0.25 per month); I cannot sell it for $5." Believe me, the first loss you take will be the cheapest.

The old formula for determining the relationship between grape pricing and retail bottle price is still pretty accurate — add two zeros. However, in these days of discounters, grapes purchased at $1,600 per ton will go into wines that may front-line at $16 per bottle retail, but actually sell at under $15 per bottle.

The new reality of the market is that major wine companies with major volume programs must sell their wine for under $15 per bottle retail. Once you move above that price point, the volume drops significantly. Over $20 per bottle these days is slim pickings.

Two years ago we sold our Hahn Arroyo Secco Pinot Noir grapes for $2,500 per ton. In 2009, we sold the same Pinot Noir grapes for $1,600 per ton, because I was foolish and did not take the $1,800 per ton offer early in the year. In 2010, the same large winery approached us, stating that our Pinot Noir had to go into programs that sold for under $15 per bottle retail. We had offers between $1,200 and $1,400 per ton. I jumped on them.

That is the new reality of the market. Selling for half the price of two years ago hurt, but not nearly as much hurt as rolling into harvest-2010 with unsold fruit because I held out for some price that just was not realistic today.

Here is how the scenario plays out all over California:

1) We did not sell the fruit because we could not receive our price;

2) Well, we will crush and sell as bulk wine;

3) Nine months later: Well, we can sell as bulk wine at a loss of $3 per gallon;

4) Hmmm, nope, cannot do that … let's put it in a negociant program;

5) Well, we bottled 10,000 cases of Bill's Best Red, but no one wants it because the market is flooded with negociant wines from all the other growers with unsold fruit that they crushed and put into bulk wine. These brands have no real story and no real authenticity;

6) Two years later, Bill's Best Red is getting pretty tired in the bottle;

7) Three years later, a distributor calls; they are really happy. They just made a deal with Grocery Outlet to take all of your Bill's Dead Red for $24 per case. In fact, they will take more if you have it. If we could make this an ongoing program, we can sell the hell out of it.

Believe me, the first loss is the best. Or in the case of our Pinot Noir, we made a profit selling as grapes at a realistic price, rather than holding out for an unrealistic price in today's environment.

The reality of the market has changed. As growers, we need to concentrate on mechanization in the vineyards, reducing costs, water issues, etc., so that we can weather the tight times and still be profitable. We cannot afford to ignore the signs of the market and hold out for unrealistic prices for our grapes.

Watch trends and react quickly

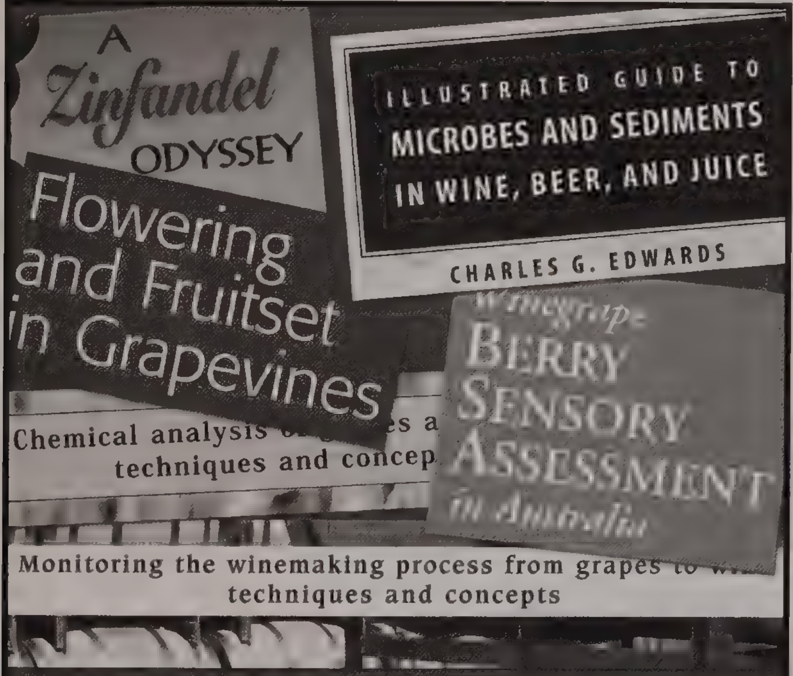
As winemakers, we also need to watch the trends and then react quickly. When I first entered the wine business in the early 1970s, the largest selling California white wine by far was Chenin Blanc.

In the early 1980s as National Sales Manager for J. Lohr Winery (San Jose, CA), I saw our Chenin Blanc sales drop from 30,000 cases per year to zero, and our Riesling sales from 25,000 cases to 5,000 cases, in about 18 months.

My brother returned from a trip back East and said, "There is this new hot wine, Sundial Chardonnay. Also, Glen Ellen Private Reserve Chardonnay is selling really well." The attitude of many wineries at the time was, "We will not sell *our* Chardonnay for those prices."

One of our wineries in The Wine Trust refused until it was too late to even make a Chardonnay. They had a "house wine" brand that was doing quite well selling Cabernet

Continued on page 102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WINE PRICING STRATEGIES IN *GOOD TIMES* AND *BAD*

BY **Liz Thach, Professor of Management, Wine Business Institute, Sonoma State University, Rohnert Park, CA**
Steven S. Cuellar, Professor of Economics, School of Business and Economics, Sonoma State University, Rohnert Park, CA
David Simpson, VP National Wine Sales, Mendocino Wine Company, Ukiah, CA
Tim Colgan, Business Analyst, Treasury Wine Estate, Napa, CA

Wine pricing has always been a controversial subject — and not just because the U.S. government does not allow wineries to "set" prices, but also due to lack of timely data on competitor pricing, discounts, promotions, fickle consumer behavior, and complex state regulations. However, when these challenges are coupled with fluctuating economic conditions and massive downward pressure on prices — as in the most recent recession — then wine pricing becomes even more complicated.

For these reasons, it is useful to review some of the basic tenets of wine pricing and strategies that can be helpful, in both good times and bad. We begin with a recap of what happened with wine volume and pricing during the recession and its aftermath, and then provide an overview of wine pricing laws and average margins/mark-ups in the U.S. From here we present seven strategic solutions for wine pricing, and conclude with a wine pricing model for the future.

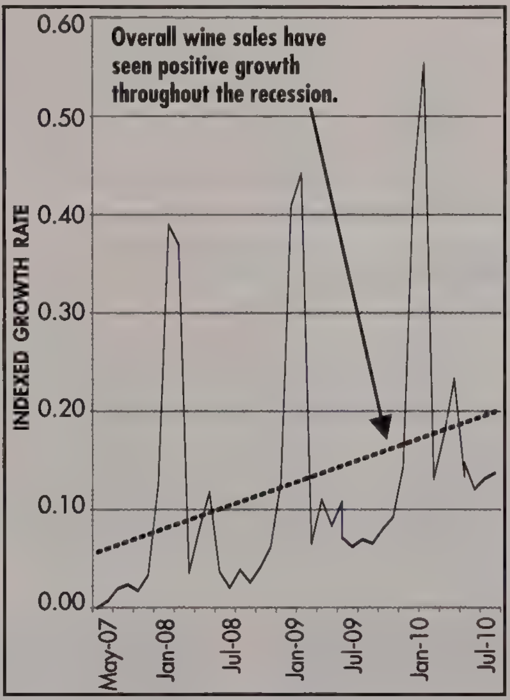

Figure I: Wine volume in U.S. market from May 2007 to August 2010. Source: Nielsen Scan Data.

What really happened with wine volume and pricing?

A review of 27 months of Nielsen scan data (May 2007 to August 2010) shows that both wine consumption and wine sales continued to grow during and after the recession. Figure 1 illustrates this positive phenomenon and the cyclical peaks and slumps during different seasons of the year. However, when analyzed by specific price point (see Figures 2 and 3), wines priced under $15 per bottle showed the most growth, as many wineries discounted wines for consumers desiring to trade down. The graphs also illustrate that higher-priced wines are starting to see an increase in sales.

All of this shows that the economy affected price segments differently. At the lower price points (under $15 per bottle) wine sales increased in both volume and market share.

However, the exception in the lower price segments is wine priced between $6 to under $9 per bottle, which appears to be caught between two competing forces: Some consumers appear to be trading down

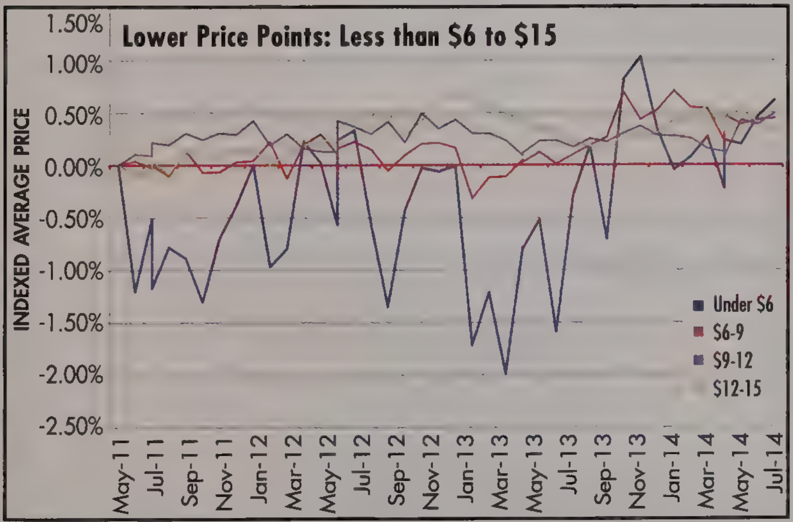

Figure II: How the economy has affected wine prices $6 to $15 per bottle. Source: Nielsen Scan Data.

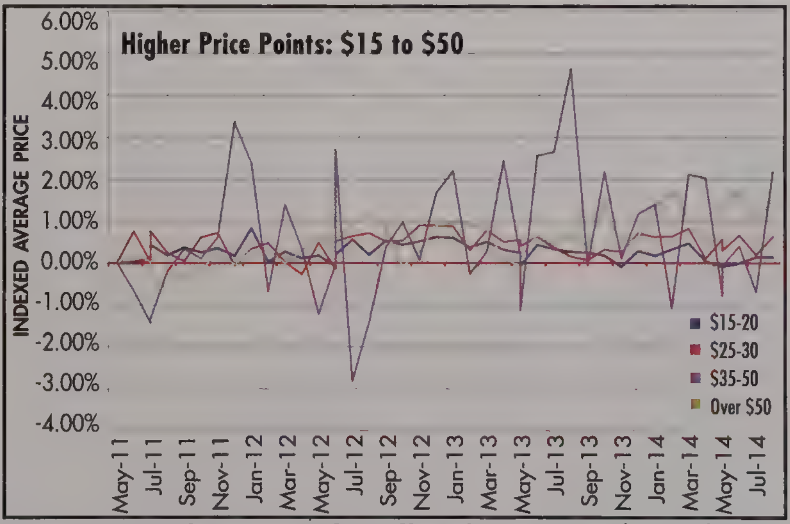

Figure III: How the economy has affected wine prices $15 to $50 per bottle. Source: Nielsen Scan Data.

to the under $6 per bottle segment, and some consumers appear to be trading up into the $9 to $12 per bottle segment. Both sales volume and market share fell in the $6 to under $9 price segment, while the adjacent price segments above and below saw growth in sales and market share.

At the higher end of the price spectrum, wines priced at $15 and above, sales volume and market share were either stagnant, or fell throughout most of 2007 and 2009. However, the upper price points appear to be bouncing back in sales volume and market share since late 2009, which coincides with the official end of the Great Recession.

Pertinent wine pricing laws

Each country has laws governing the sale and pricing of alcoholic beverages. In the U.S., three major wine pricing issues are legislated:

1) Wine prices cannot be set by the supplier (winery) or wholesaler. It is the retailer who determines the final price of the wine. However, the winery can suggest or recommend a final price, such as a suggested retail price of $28 per bottle. Laws governing this issue include the Sherman Antitrust Act, Section 1, under which it is a federal offense for a supplier to set wine pricing, and state antitrust laws.

2) Wine cannot be sold below cost, unless the brand is being discontinued. This includes advertising wine as a two-for-one special or loss leader — if the price per bottle is below production costs. Laws governing this include the Unfair Practices Act in the U.S. and World Trade Organization anti-dumping laws in international markets.

Table I: Example of off-premise margins

1)	Winery's FOB price (freight on board) includes all of their costs, plus their profit.	$10.00 per bottle
2)	Plus freight + tax (varies by state, but average is $5 per case = $.42 per bottle).	$10.42 per bottle
3)	If sold to a distributor, they usually add 20% to 30% margin (not mark-up), with average being 25%. ($10.42 x 1.33 = $13.96 - $10.42 = 3.54/13.96 = 25%)	$13.96 per bottle
4)	A wine shop retailer or grocery store will usually also adds 25% to 35% margin (not mark-up), with average being 33%.	$20.99 per bottle

3) Wine cannot be shipped for free. It is illegal to advertise free shipping for any type of alcoholic beverage. In California, this is legislated by CA Rule 106. Other states have similar legislation.

Basic margins and mark-ups in the U.S. market

When selling wine through a distributor and/or retailer, there are no standard margins or mark-ups, but averages can be calculated (see example in Table I). In general, for **off-premise wine** pricing, the winery will establish an FOB (freight on board) price per case, which includes all of their production costs plus profit. To this, a freight and tax charge must be added. This cost depends on the state to which the wine will be shipped, but the average is $5 per case.

Then the wine is usually sold to a distributor who will desire a margin of 20% to 30% with the average being 25%. The distributor will then sell to an off-premise retailer who adds an additional margin of 25% to 35%, with an average target of 33%. Obviously discounts and/or promotions at any tier will impact the final price.

With off-premise pricing, it is important to be able to calculate quickly the impact of a pricing change. Table II illustrates the difference in pricing from wholesale to retail, when the retailer adds a 33% margin. It also highlights the big impact of tax and freight by state on final pricing.

When examining wine pricing for **on-premise**, restaurants, bars, and other on-premise establishments usually talk about "mark-up," rather than "margin." Here again, there is no standard mark-up, but averages can be calculated. For wine by the bottle, a mark-up of 2X to 3X the retail price is common; this is usually rounded up.

For example, if the retailer sells the bottle of wine for $20.99, a restaurant would most likely round up to $21 and then double or triple the price to $42 or $63. Indeed, in a recent study

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of California restaurants, the average mark-up was 170% of retail price, with a range of 30% to 400% mark-up!

Wine pricing by-the-glass is generally set at the wholesale price of the bottle. Therefore, if the restaurant or bar purchased the wine for $9 per bottle wholesale, they would price it at $9 per glass. This allows them to cover some of their setup costs such as stemware, cleaning, and service, and also allows them to break even if they cannot sell the remainder of the bottle.

For **Direct to Consumer** (DTC) wine sales from a winery tasting room or winery website, in general, the bottle price is equal to or slightly higher than the retail price point. Wine Club members usually enjoy a 10% to 15% discount off regular tasting room pricing, and may be eligible for deeper discounts on case purchases or special offers.

Strategic solutions for wine pricing

Although most wine and grape suppliers had to tighten their belts and take some losses during the recession and its aftermath, a few managed to maintain positive sales and profitability during this difficult period. How did they achieve this? By using some of the strategic solutions and tactics listed below:

Table II: Price changes at retail level and impact of freight/tax

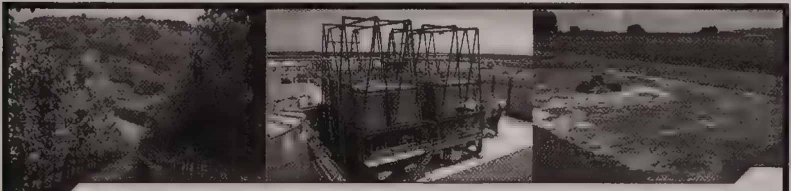
EXAMPLE OF 33% RETAIL MARGIN ON PRICE CHANGES AT WHOLESALE LEVEL	EXAMPLE OF FREIGHT/TAX IMPACT ON CASE FOB BY STATE
Wholesale $6.66 = $ 9.99 retail Wholesale $9.99 = $14.99 retail Wholesale $13.33 = $19.99 retail Wholesale $16.66 = $24.99 retail	A targeted retail of $19.99 and the retail margin is 33% and the distributor margin is 25%. Approximate FOB/case by market is: California = $119 Midwest = $114 Southeast = $111

1) A clear and authentic Brand Strategy is very important because it assists in determining your price point. If you are very clear on how your wine brand is different from competitors in terms of "brand story," variety, appellation, winemaking, and target consumer, then it will be easier to determine your competitive set. This, combined with solid consumer research on what people are willing to pay for your distinctive style of wine, will allow you to set a realistic price point.

2) Use of the Position, Range, and Promotional Frequency Pricing Method will allow you to determine the low, mid, and high price spread for your wine brand. A professional pricing method used for each brand, this process requires that you have a clear brand strategy (as described previously), know your competitive set, and have data on consumer pricing trends.

With this, you set a mid-price that you prefer for your wine (the position), but also identify the price range, from the front-line shelf price to the discounted promotional price. For example, if your mid-price is $20, the lowest price you may be willing to take is $18, and an ideal high could be $23. This is calculated for each brand, and then a plan describing the frequency of promotions is established for the year (see Figure 4)

Using a pricing map similar to Figure 4 as a template can aid in developing a pricing strategy for your brand. Visually, it makes it simple to



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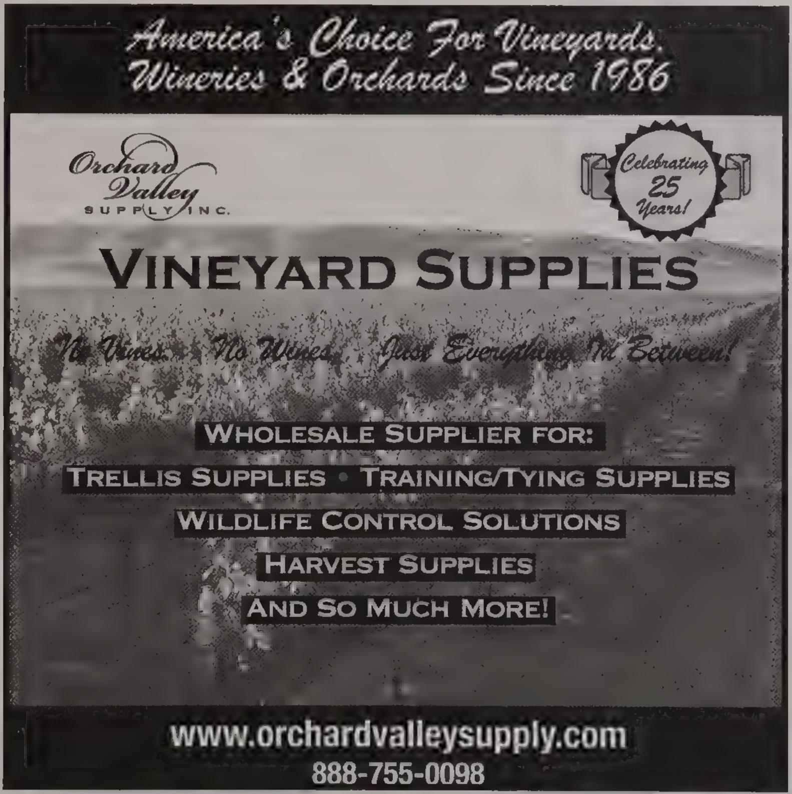

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map out your desired pricing range from front-line to deep discount price. It also helps compare your brand to competitive brands. Examining market data allows for a comparison of multiple brands across similar price tiers to identify how different strategies are contributing to the performance of each brand.

The pricing map simplifies pricing strategy into a few basic nuts and bolts, allowing a manager to focus on the timing of promotions. Determining a promotional frequency of 20 weeks out of the year is nice, but deciding when to activate those 20 weeks is an additional layer for consideration. A manager can implement many combinations of strategic and tactical pricing and promotional levers to drive sales. Knowing which levers to pull will go a long way in determining the long-term success of any strategy.

3) Using promotions instead of discounting was the most common best practice used by successful wineries during and since the recession. This is because once you discount your wine, it is difficult to return to your original higher price point. Not only do consumers expect the discount to continue, but wine buyers may insist that it become permanent.

For wine brands playing in the under $10 category, heavy discounting was almost impossible to avoid. However, smart wineries negotiated promotions of their brands by providing behind-the-scene incentives rather than publicly reducing prices on the shelf. This allowed them to maintain brand integrity.

In addition, some wineries created new value labels to compete at lower price points, without undermining their signature brand. An example is Duckhorn's roll-out of Decoy and Ravenswood's new brand Zen of Zin to compete with the more fruit-forward styles of Sin Zin and Gnarly Head.

4) Increased sales support and relationship management are important at all times, but especially during economic downturns when distributors and retailers are forced to reduce inventory. Smart wineries actually hired more sales people during the recession to assist distributors and retailers. They doubled and tripled efforts in relationship management with all levels of the trade, and put their CEOs, owners, and winemakers on the road to help sell wine.

5) Expanding DTC efforts was a common response during the downturn — especially as some small wineries were cut out of distributor networks. Focusing on DTC should always be a critical priority for small and mid-size wineries, but even more so in an economic downturn. Not only are margins higher on wine sales via tasting room, wine club, and e-commerce, but brand loyalty can be enhanced.

The DTC manager of a winery should be viewed as another important distributor/retailer, and provided support and incentives to help the DTC team increase wine sales.

Another important aspect of DTC is the e-commerce channel, which has been used very effectively by a few smart wineries to move thousands of cases in a very short time. Most employed a method of sending promotion emails to wine club, friends and family, or other contacts with messages of "limited amounts available," "first come/first served," and "only a few cases left." This spurred consumers to buy large quantities of wine very quickly before the deadline. Pricing was discounted, but margins were much higher than if the wine had been sold at off-premise establishments.

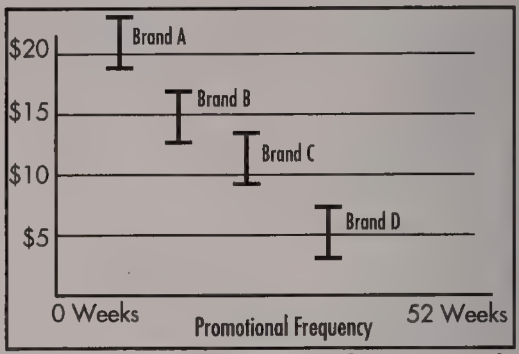

Figure IV: Position, range, and promotional frequency pricing method.

Ironically, according to ShipCompliant, of the more than 6,000 wineries in the U.S., only 425 are currently licensed to sell wine in 11 or more states, even though the average DTC bottle price received is $35. This suggests there is much more room for expansion in this channel.

6) Ramping up Direct to Trade is a strategy still used by very few wineries, but paying large dividends for those who use it. More than 18 states allow direct to trade, and wine pricing in this channel can often maintain premium price points, because special incentives can be customized for retailers.

Continued on page 103

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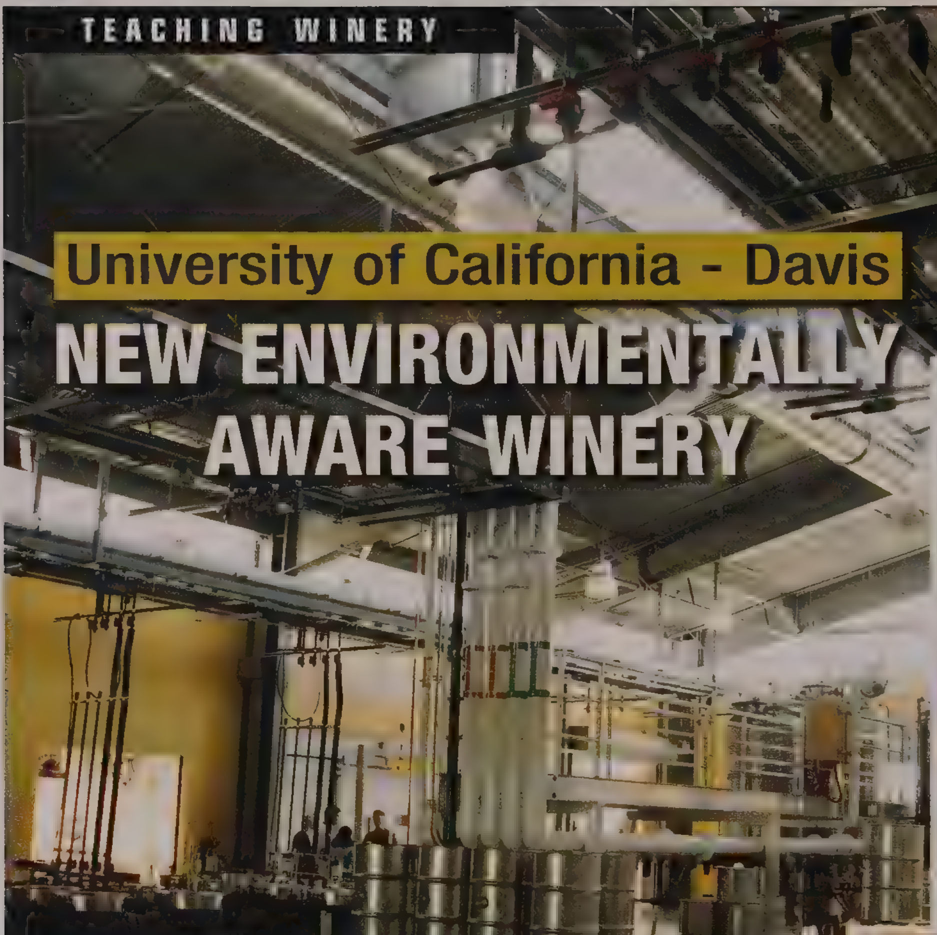
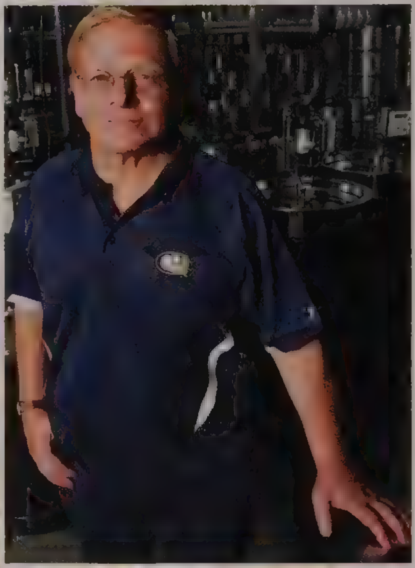
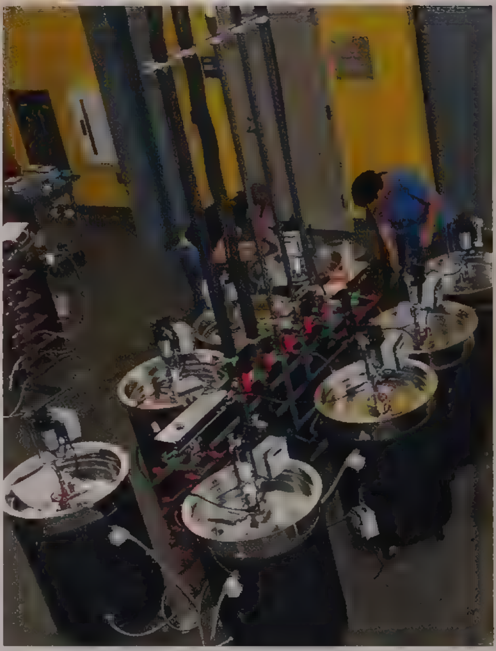
University of California - Davis

NEW ENVIRONMENTALLY AWARE WINERY



A skylight along the spine of the roof provides maximum natural light to the 6,000 sq. ft. main fermentation hall.





RIGHT: 152, 200-L fermentors were designed, fabricated, and donated by Cypress Semiconductor (San Jose, CA) T.J. Rodgers (founder and president).

FACING PAGE: Students sort/remove undesirable grapes on vibrating conveyor at UC Davis receiving pad, prior to destemming and filling a 200-L fermentor in position under the destemmer.

Unlocking longstanding mysteries about the wine industry in California and around the globe is one goal of the new, most technologically advanced and environmentally sophisticated winery in the world at University of California, Davis.

Cooperages 1912 barrel room contains 10 T.W. Boswell and 10 World Cooperage barrels plus five-year-old barrels on 40 Western Square 7-inch high two-barrel racks.

Construction of the $15 million teaching-and-research winery was completed in July 2010. It is designed to become self-sustainable in energy and water use after all of its features are on-line. The winery is adjacent to a new 12-acre teaching-and-research vineyard within the campus's Robert Mondavi Institute for Wine and Food Science (opened in 2008).

The winery includes the main fermentation hall (6,000 sq. ft.), four adjacent controlled-temperature rooms (400 sq. ft.), a 600 sq. ft. receiving pad, a classroom, and a 580 sq. ft. laboratory. One adjacent room can hold grapes at 35°F before sorting/crushing by students.

The winery is part of a new 34,000-square-foot complex that also encompasses a brewery and food-processing pilot plant, built to LEED Platinum standards. The complex was designed, constructed, and equipped entirely with funds from private donors; no federal or state funds were used.

Environmentally responsible features include maximum use of natural light, rooftop photovoltaic cells to provide all of the facility's power at peak load, use of recycled glass in the flooring, interior paneling recycled from a 1928 wooden aqueduct, and use of lumber harvested from sustainably certified forest operations.

"The new teaching-and-research winery and vineyard are game-changers for our winemaking and grape growing program to help California winemaking advance dramatically in both quality and sustainability," says wine chemist Andrew Waterhouse (Marvin Sands Endowed Chair in the Department of Viticulture & Enology).

High-tech fermentation system

A $1 million assembly of 152 wireless 200-L variable capacity, electro-polished, stainless steel fermentors features automated control of temperature and the "pump-over" process, two of the most important factors affecting wine characteristics

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WINTER 2011

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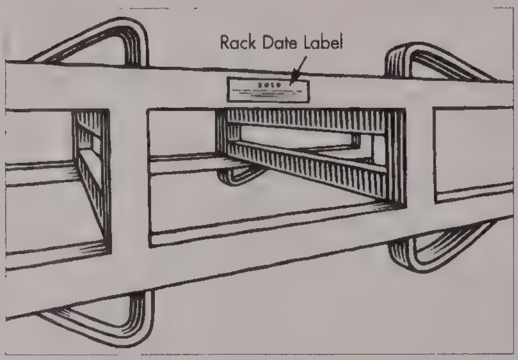
WESTERN SQUARE INDUSTRIES

Western Square Industries, prompted by the recent quakes in Chile, is encouraging customers to sign up for the Rack Replacement Program. Because wine barrel racks have a limited life of productive service, usually 10 to 12 years, Western Square, through its sales force and inspection service, is encouraging winery owners to replace aging racks. The racks cost less than $100 to replace, and the replacements can save priceless wine, and preserve the safety of employees.

Mark Canepa, Director of Sales with Western Square, reports that "the Rack Replacement program has certainly given winery owners and winemakers extra nights of sleep. Worrying about the safety of the wine is definitely stressful."

"We have offered this program for several years, but every time there is some catastrophic event in the world, the importance of the Rack Replacement Program is really intensified," says Western Square President Trygve Mikkelsen.



Western Square offers free inspection and the development of a budget-friendly replacement schedule.

For more information, contact:

Western Square Industries
Trygve Mikkelsen
1621 N. Broadway, Stockton, CA 95205
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website: westernsquare.com

PLEASE SEE WESTERN SQUARE AD, PAGE 44.

TOM BEARD COMPANY

The Tom Beard Company has developed a new ½-ton and 1-ton bin washing system (U.S. patent pending). This unique system is fully automated, and designed to thoroughly clean bins inside and out. Like all Tom Beard products, it is designed to operate on a minimum of water, and generate a minimum of wastewater.

The washing system collects the solids material for easy disposal, ensuring that it does not end up in the drainage system. It provides a cost-effective solution to manually washing bins, freeing up manpower, and saving water.

The Tom Beard Company is focused on creating machinery that will stand the test of time, use the least amount of water, and generate a minimum of wastewater. From 2-bbl and 4-bbl washing machines, to ½-ton bins and cellar equipment, Tom Beard Company has it covered!

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Tom Beard Company
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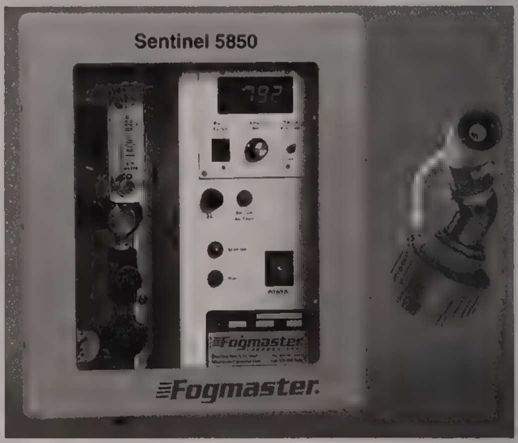
tel: 707/573-3150; fax: 707/573-3140
e-mail: jmendoza@tombeard.com
website: www.tombeard.com

PLEASE SEE TOM BEARD AD, PAGE 73

FOGMASTER CORPORATION

Fogmaster's Sentinel-5850 barrel-room humidification system brings innovative atomization technology to small- and mid-size wineries. It uses a turbulent-vortex nozzle to atomize water into micro-droplets that evaporate quickly and spread uniformly throughout the barrel room.



The control unit (see photo) monitors relative humidity and regulates water flow. A regenerative blower, designed for efficiency and low-maintenance cost, provides air to atomize water.

When humidity drops below the set point, the control unit activates the system and the nozzle ejects a fog of tiny droplets. The droplets evaporate quickly and raise humidity so barrels stay dry. Because the nozzle has no tiny orifices, nozzle plugging is not an issue.

Designed for "do-it-yourself" installation, the Sentinel-5850 includes all installation components except two-inch PVC pipe from the blower to the nozzle.

A single nozzle system can maintain humidity in barrel rooms of 1,000 to 5,000 square feet. A cart option is available for users who want to move the humidification system from room to room.

For more information, contact:

Fogmaster Corporation
1051 SW 30th Ave., Deerfield Beach, FL 33442
tel: 954/481-9975; fax: 954/480-8563
e-mail: info@fogmaster.com
website: www.fogmaster.com

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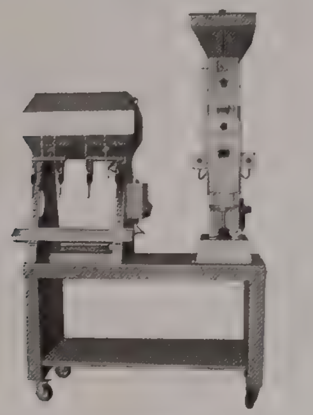
NAPA FERMENTATION SUPPLIES

Napa Fermentation Supplies offers a full line of winemaking equipment and supplies, including variable capacity stainless steel tanks with adjustable lids from 26 gallons to 2,693 gallons and closed-top tanks from 79 gallons to 5,221 gallons, with or without manway, and with or without cooling jackets.

Also available are: Karcher hot water pressure washers with 1,300 psi to 3,000 psi and temperatures from 86°F to 285°F steam; one-inch and 1.5-inch Jabsco pumps with AC inverter drive; two-inch or three-inch Zambelli must pumps with AC inverter drive; Zambelli crusher/destemmers from two to 14 tons per hour; Zambelli manual and hydraulic, membrane, and bladder presses; eight-inch and 16-inch Zambelli plate filters; a full line of stainless steel fittings and valves, butterfly and ball; one-inch to four-inch wine hose; labware; refractometers; wine thieves; and table-top labelers.



Tivoli corking/filling machine, made of AISI-304 stainless steel, has four jaws for use with synthetic or natural corks with 22, 24, or 26mm diameter. The corking pin has a pneumatic piston, inserting rapidly to create less pressure on bottleneck, and the cork hopper has mechanical agitator for continuous cork feed. The four-spout filler has high/low fill sensors, comes with or without vacuum, 110 VAC, and will fill 500 to 600 bottles/hour.

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3M PURIFICATION

3M Purification (formerly CUNO) is a world leader in the design and manufacturing of a comprehensive line of filtration products and systems for the clarification and final filtration of fine wines.

Innovative 3M Purification products for wine filtration include the first dual-zone clarification depth filter cartridge (Zeta Plus™ MH Series), the first integral multi-zoned membrane prefilter (LifeASSURE™ BLA series), and the first nylon-based final membrane filter optimized for repetitive hot water exposure (LifeASSURE BA series).

3M Purification also offers the LifeASSURE BNA series of final membrane filters. These final filters combine three innovative technologies from 3M to significantly improve filter throughput and reduce operating costs. A highly asymmetric microporous membrane, a specialized pleating design, and a novel support layer construction, deliver ultra-fast flow rates, secure spoilage organism retention, and remarkable throughput.

With close to 100 years of experience and manufacturing facilities on five continents, 3M Purification is uniquely suited to provide solutions to wineries worldwide.

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400 Research Pkwy, Meriden, CT 06450
tel: 800/243-6894; fax 203/630-4530
e-mail: cjohara@mmm.com
website: www.cuno.com

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CUSTOM METALCRAFT

CUSTOM METALCRAFT has provided quality tanks and equipment to the wine industry for almost 20 years. A family company that understands the challenges presented in the winemaking process, Custom Metalcraft can make the best recommendation for winery product needs.

Custom Metalcraft offers TranStore® wine storage and fermentation tanks in a variety of standard or custom sizes, up to 3,000 gallons. Tanks may be used for storage, fermentation, or cold stabilization.

Numerous options include jackets, sample valves, thermowells, side manways, and special interior finishes.

Tanks can be stacked 3-high, and moved with a fork truck or pallet jack. Custom Metalcraft can custom fabricate according to winery specifications.

Custom Metalcraft has recently added 60 gallon stainless barrels to its product line, made from 10 gauge 304 SS material, which can be stacked up to 6-high in all standard barrel racks.

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WESTEC TANK & EQUIPMENT

Westec Tank & Equipment has 30 years of industry-leading technology and experience, providing custom-designed and manufactured stainless steel tanks, catwalks and stairways, OxBoxes, and equipment for wineries.

THE BELLI CORPORATION
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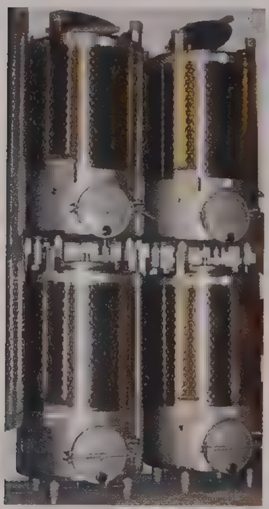
TANK & EQUIPMENT, CO.

Westec equipment is technologically advanced, well-built, easy-to-maintain, safe, and aesthetically appealing. For wineries needing design advice and guidance, Westec can help plan enhancement and expansion projects.

Westec knows the success of a winery depends on doing the job right and on time — every time. At Westec, a reputation for honest, reliable, and friendly service has been built by meeting and exceeding expectations, year after year.

Westec's new Portable Tank is the perfect solution for overflow, small lot production, or transportation. The high-quality stainless steel Portable Tanks are stackable (up to three tanks high) to save floor space. Standard designs have a 24-inch Westec top door, with optional 18-inch round bottom door, available in 350-, 450-, and 550-gallon capacity.



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Joe Belli, Jim Belli, Mark McDowell
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website: www.westectank.com

PLEASE SEE WESTEC TANK AD, PAGE 107.

P&L SPECIALTIES

P&L Specialties expands the patented Le Trieur™ (LT) line of MOG separation machines. The LT™ is now available in sizes ranging from 5 tons to 60 tons per hour throughput. The patent includes the LT's special separation screen technology and gentle oscillating action.

These machines feature interchangeable separation screens of varying size for different grape varieties, and variable speed control for accurate control of separation, making the LT a great choice for wineries processing different red varieties, and seeking precise separation results.

MOG removed by P&L Specialties' patented LT™.

The RAKE™ is a low-cost, no-labor, air knife technology designed to be used between the LT™ and a post-destemmer sorting table. The RAKE™ is described as "a lot of extra hands" removing vegetative pieces before final inspection on a post-destemmer sorting table – it's described by users as "tremendous!"

The Consista-Flow™ 5 ton-per-hour whole cluster destemmer feed conveyor is designed to eliminate smashed grapes, stemmed clusters, excessive jacks and stem pieces caused by overloading and uneven feeding of the destemmer. The rubber-modified vinyl belt and easy-to-sanitize design enhance the Consista-Flow's performance.

For more information, contact:
P&L Specialties
1650 Almar Pkwy, Santa Rosa, CA 95403
tel: 707/573-3141; fax: 707/573-3140
e-mail: sales@pnlspecialties.com
website: www.pnlspecialties.com

PLEASE SEE P&L SPECIALTIES AD, PAGE 55.

ADI SYSTEMS INC.

ADI Systems Inc. specializes in industrial wastewater treatment and offers many solutions for wineries, from treatment to water reuse. ADI has installed numerous systems worldwide including clients such as Anheuser-Busch, MillerCoors, Guinness, and Baileys.

ADI-MBR (Membrane Bioreactor) — A membrane bioreactor (MBR) system, based on the world's leading flat-plate MBR technology, can produce reuse-quality water within an easy-to-operate, small-footprint package. Effluent from the ADI-MBR will meet the strictest discharge limits and offer wineries a variety of disposal options including irrigation, aquifer recharge, or direct discharge. The technology is used in 20 wineries worldwide.

Anaerobic Technologies — For large wineries, ADI offers anaerobic systems that are ideally suited to treating high-strength wastewater generated at wineries and provide an efficient, economical solution to wastewater problems. Wineries can utilize the biogas generated in these systems to displace electricity or natural gas use in the winery, providing an additional economic benefit.

Contact ADI today and explore solutions to handle your winery's wastewater treatment needs and improve the overall bottom line. Ask about our ADI's new ADI-AnMBR technology.

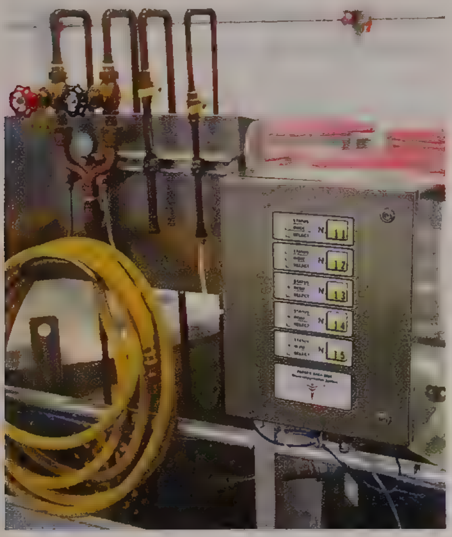
For more information, contact:
ADI Systems Inc.
Al Cocci, Vice President
PO Box 397, 7 Pointe Sewall Rd, Wolfeboro, NH 03894
tel: 800/561-2831 (US and Canada)
or 603/569-0955; fax: 603/569-0957
e-mail: systems@adi.ca
website: www.adisystemsinc.com

PLEASE SEE ADI SYSTEMS AD, PAGE 46.

AMERICAN TARTARIC PRODUCTS, INC.

For years, winemakers have added oxygen to wine — it has only been in the last decade that specific tools for this task became available. Parsec has revolutionized micro-oxygenation technology by offering the only system that supplies oxygen by weight instead of volume.

When releasing a potentially dangerous gas like oxygen in a wine tank, you have to be absolutely sure that the quantity you release is precise, in order to be able to repeat it. There is a wide range of equipment that measures oxygen dose by volume (ml). A liter of gas can be a very small quantity (at low pressure and high temperature) or very large quantity (at high pressure and low temperature). To measure gas by liter, a winemaker must refer to a specific pressure and a specific temperature.



Usually, micro-oxygenation equipment is fed by a gas cylinder, and the pressure-reduction gears are not able to provide a precise pressure value. Parsec systems have taken this into account by measuring the weight of the oxygen molecule, temperature, and pressure to the micro-second with no calibrating, assuring the most accurate system available today. Systems are available from one to 120 units and are PC-compatible.

For more information, contact:
American Tartaric Products, Inc.
1230 Shiloh Rd., Windsor, CA 95492
tel: 707/836-6840; fax: 707/836-6843
e-mail: bill@americantartaric.com
website: www.americantartaric.com

ST. PATRICK'S OF TEXAS

St. Patrick's supplies equipment for small to mid-size wineries from three warehouses (35,000 square feet) in Austin, TX. Product descriptions and pricing are available online at www.stpats.com. Equipment manuals are also available online.

St.Patrick's of Texas

St. Patrick's of Texas stocks the following equipment:

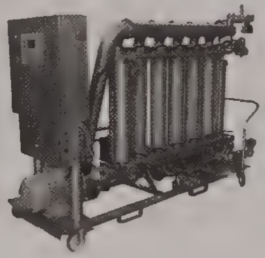
- Revello peristaltic pumps,
- NIKO pneumatic membrane presses,
- MEP semi-automatic corkers,
- MEP semi-automatic labelers,
- Letina wine tanks
- EnoItalia crusher/destemmers,
- Sanitary valves and fittings,
- Barrel tools,
- Filling machines.
- Plate and frame filters,
- Membrane filters,
- Wine and must pumps,
- Heat-shrink and foil applicators.

For more information, contact:
St. Patrick's of Texas
1828 Fleischer Dr., Austin, TX 78728
tel: 512/989-9727; fax: 512/989-8982
e-mail: stpats@bga.com
website: www.stpats.com

PLEASE SEE ST. PATRICK'S AD, PAGE 67.

GUSMER ENTERPRISES

Gusmer Enterprises represents Bucher Vaslin cross-flow filters to the U.S. wine industry. There is an appropriate size Bucher Vaslin cross-flow filter for every winery and budget. Bucher's FX1, FX2, and FX3 filters for small wineries offer flow rates of 150 to 1,000 gallons/hour. For mid-size wineries, the FX5 and FX6 models range from 745 to 2,000 gallons/hour. For large winery use, the FX100 and FX400 Bucher filters handle flow rates of 1,500 to 15,000 gallons/hour.



The Bucher Vaslin cross-flow design utilizes a low filtration differential pressure (maximum 1.2 bar) and operates with essentially no increase in wine temperature. An automatic back-flush system maintains an optimum flow rate. This system eliminates the handling concerns and need for disposal of loose filtration media. The units are fully automated and can operate around the clock without direct operator supervision.

Evaluate a Bucher Vaslin filter at your facility with a demonstration unit. Full-time cross-flow technical staff is available for demonstrations, training, and service calls. Contact a Gusmer Enterprises representative for more details.

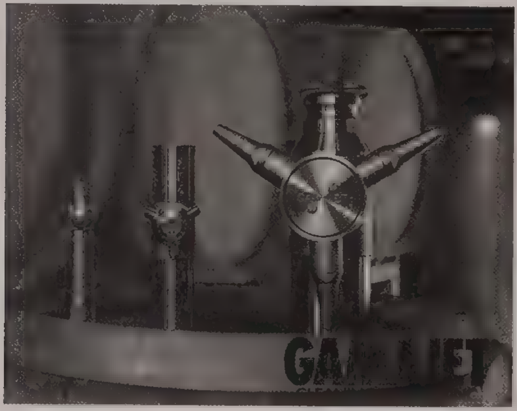
Gusmer Enterprises, Inc.®

For more information contact:
Gusmer Enterprises
Kathy Bollack, Dave Gusmer,
Bill Merz, Tim Ossun, Ken Stewart
Rodger Pachelbel, Lauren Sloan
81 M Street, Fresno CA 93721
tel: 559/485-2692; fax: 559/485-4254
e-mail: sales@gusmerenterprises.com
website: www.gusmerenterprises.com

PLEASE SEE GUSMER ENTERPRISES AD, PAGE 38.

GAMAJET CLEANING SYSTEMS

Gamajet tank cleaning machines offer fast and efficient cleaning of barrels, tanks, and totes. The fluid-driven machines scour the entire interior in a 360-degree pattern, which eliminate cross-contamination, microbial growth, and stubborn tartrates.



Barrel cleaning machines: Leaving the barrels in the preferred position, stacked or racked, the fluid-driven machines, connected to a standard pressure washer, enter through the bunghole. In under four minutes, the machine will have indexed in a 360-degree pattern, scouring all areas of the barrel. Designed to produce at least 5 pounds of force on the barrel interior, the machine easily removes tartrates without harming barrels. At a rate of only 4 gallons per minute to clean a barrel, less than 12 gallons of water are needed.

Tank cleaning machines: For cleaning tanks up to 75 feet in height, the Gamajet E-Z8 will work with most transfer pumps to create a closed-loop tank cleaning system. Entering through the manway on a cart, or from above on a hose or lance, the Gamajet machine will scour the entire tank interior, removing stubborn stains and tartrates. With a Gamajet, staff can clean a tank in under 30 minutes, without climbing into the tanks to scrub and power-wash them.

For more information, contact:
Gamajet Cleaning Systems, Inc.
604 Jeffers Circle, Exton, PA 19341
toll-free: 1/877-Gamajet
tel: 610/408-9940; fax: 610/408-9945
e-mail: sales@gamajet.com
website: www.gamajet.com

PLEASE SEE GAMAJET AD, PAGE 22.

RAYNOX 2000, INC.

Recent modernization of the manufacturing plant allows Raynox to offer the best quality ever with refined design. Raynox off-the-line standard tank models set an industry benchmark for red and white fermentation and storage tanks.

From well-designed standard models, to carefully crafted custom tanks and on-site fabrication, Raynox has assisted North American wineries of all sizes, ensuring quality and craftsmanship meeting high standards. Custom fabrication expertise ensures Raynox can meet winemakers' exact needs.

Raynox repeat customers especially value the post-sales service.

Raynox offers winemaking equipment selected with the same care used to manufacture tanks. From the sorting table to bottle labelling, Raynox has equipment to help winemakers every step of the way.

For more information, contact:
Raynox 2000 Inc.
Sales Department
1148 St. Michel Street, St-Césaire
Quebec, Canada J0L 1T0
tel: 866/469-4181 (toll-free); fax: 450/469-2112
e-mail: lchartrand@raynoxinc.com
website: www.raynoxinc.com

PLEASE SEE RAYNOX AD, PAGE 62.

PRO REFRIGERATION INC.

Pro Refrigeration is a leading manufacturer and supplier of refrigeration equipment to the wine industry. Pro's mission is to build the highest quality, most efficient chiller systems for the markets they serve. Pro strives to not only provide a turnkey solution for the larger production wineries, but also be the best solution for wineries of all sizes.

Pro Refrigeration offers a new line of compact systems: The ChilStar™ Micro Chiller System is available in 2 HP, 3 HP, and 5 HP models. These systems can control up to five fermentation tanks of varying sizes and have the ability to operate at a 20°F chilled glycol temperature for cold settling and cold stabilizing duties. Pro Refrigeration offers this line as a solution for wineries working with limited production, and an affordable option that a large producer can utilize for individual tank control.

Pro is fortunate to have collaborated with some of the finest winemakers to develop and expand a product line specifically for the winemaking craft.

For more information, contact:
Pro Refrigeration Inc.
326 8th St. SW, Auburn, WA 98001
tel: 253/735-9466; toll-free: 800/845-7781
fax: 253/735-2631
e-mail: info@prorefrigeration.com
website: www.prochiller.com

PLEASE SEE PRO REFRIGERATION AD, PAGE 56.

UNITECH SCIENTIFIC LLC

Unitech is launching new Free Sulfites and Total Sulfites reagents for spectrophotometry. The wine reagent line – 26 chemistries in all – includes Glucose/Fructose, Malic, Ammonia, Primary Amino Nitrogen (NOPA), Acetic Acid – plus enzymes (HK, MDH, etc.), NAD and multi-level standard sets.

Unitech Scientific

Unitech also features the ChemWell auto-analyzer and a new EnoLyzer wine analyzer (semi-automated and affordable). These systems produce quantitative results for each chemistry. ChemWells process 180 tests/hour, are flexible, easy to use, reliable, and very accurate.

In addition, Unitech distributes instrumentation from YSI, Hanna Instruments, and Atago USA, as well as wine microbiology "made easy" line for *Brettanomyces*, bacteria, and yeast detection, and Z-Brett – the 3-hour antibody-based test.

Unitech offers reagent, assay protocol, and hardware expertise. Unitech is proud of their great product quality, service, and customer loyalty.

For more information, contact:
Unitech Scientific LLC
12026 Centralia Road, Ste H
Hawaiian Gardens, CA 90716
tel: 562/924-5150; fax: 562/809-3140
e-mail: info@unitechscientific.com
website: www.unitechscientific.com

PLEASE SEE UNITECH SCIENTIFIC AD, PAGE 33.

SKOLNIK INDUSTRIES, INC

Skolnik stainless steel cooperage is designed to meet the special needs of winemakers in all stages of fermentation, maturation, and storage of fine wines. Skolnik has a long and proud tradition of providing winemakers with stainless steel drums of high quality, durability, and design.

Skolnik's wine industry customers look to stainless steel cooperage to supplement oak barrels in key stages of the winemaking process. Stainless steel offers unique and unsurpassed qualities for preserving product integrity and purity — important considerations for why stainless is a key tool for winemakers.

Stainless steel cooperage is:

- Versatile and adaptable to many uses;
- Ready for use after being sterilized;
- Cost-effective and long-lasting;
- Predictable, reusable, and easy-to-clean;
- Virtually maintenance-free;
- Sized from 5 to 55 gallons;
- Available with seamless, crevice-free interior.

SKOLNIK
Drums of Steel

Skolnik is a full-service manufacturer of steel containers and accessories. Every Skolnik container is thicker, heavier, and stronger than industry standards — a commitment made to customers for more than 75 years.

For more information, contact:
Skolnik Industries, Inc.
Jason Snow
4900 S. Kilbourn Ave., Chicago, IL 60632
tel: 773/362-1913; fax: 773/735-7257
e-mail: jason@skolnik.com
website: http://winedrum.skolnik.com

PLEASE SEE SKOLNIK INDUSTRIES AD, PAGE 45.

SCOTT LABORATORIES, INC.

The Rafale is an accurate optical berry sorting system (5 to 7 tons/hour) designed to complement the Mistral Line by Vaucher-Beguet. Small waste particles are difficult to sort optically, without considerable loss of good fruit. The Mistral automatically removes the bulky waste *and* the very small particles that generally represent up to 2% of the harvest. The Rafale then removes immature berries (by color) and any remaining waste (jacks, etc.). The Rafale was introduced at VINITECH 2010.

New this year will be a small footprint, rotary P.E. labeler developed with the wine industry in mind. This labeling system will provide precision labeling, maximum flexibility, and performance in a compact design. Features include: programmable "stepper" bottle plate rotation, fiber optic orientation capability for precise label placement, and three pressure-sensitive labeling heads. P.E. USA is a dominant presence in the beverage industry, and has a U.S.-based parts, service and support center for quick customer response.

MBF innovations and patented features have combined to make them a leader in the wine and spirits bottling market. Incorporating a close working relationship with other machine manufacturers, forward-thinking designers, and modular frame design, the "superblock" concept was born. The superblock consists of creating a single machine block, from rinser to the labeler, perfectly synchronized utilizing brushless motors. Benefits of the superblock are numerous; increased efficiency, single operator, reduced noise, and no bottle-to-bottle contact.

For more information, contact:
Scott Laboratories, Inc.
2220 Pine View Way, Petaluma, CA 94954
tel: 707/765-6666; fax: 707/765-6674
e-mail: info@scottlab.com
website: www.scottlab.com

PLEASE SEE SCOTT LABS AD, PAGE 72.

EURO-MACHINES, INC.

In today's economic times, the Europress is a wise long-term investment for any winery, large or small. Its consistently high trade-in value is an added bonus when you are ready to upgrade to a larger press. Manufactured in Germany, under the highest standards, the Europress is a "workhorse"that will serve you well in making your best wines, the best for the best!

Other quality winery equipment:

- All-stainless steel tanks (open top, multi-chamber, and storage), available from 25 to 25,000 gallons.
- Conveyor belts, with the following standard features:
    - ➢ Open construction for easy cleaning;
    - ➢ All stainless steel;
    - ➢ Variable frequency drive for gentle motion, with motor mounted on top for better leverage;
    - ➢ Conclave belt cleats;
    - ➢ Customization available to suit specific winery needs.
- Sorting tables with customization available;
- Destemmer-crushers, ranging from 3 - 40 tons per hour;
- Pumps;
- Mixers.

Euro-Machines, the U.S. subsidiary of Scharfenberger Company of Germany, is committed to excellent customer service. Factory-trained technicians are always available to assist if needed.

For more information contact:
Euro-Machines, Inc.
WEST: 497 Edison Ct, Ste G, Fairfield, CA 94534
tel: 707/864-5800; fax: 707/864-5879
EAST: PO Box 843, Culpeper, VA 22701
tel: 540/825-5700; fax: 540/825-5789
e-mail: karen@euromachinesusa.com
website: www.euromachinesusa.com

PLEASE SEE EURO-MACHINES AD, PAGE 48.

SNYDER INDUSTRIES

Snyder Industries introduces Rack-Master to its Wine Master Product Collection.

Rack-Master provides a cost-effective 100% polyethylene barrel racking solution, with an unlimited useful life that eliminates the routine maintenance and refurbishing expenses associated with corrosion in metal barrel racking systems.

Rack-Master is sanitary, lightweight, and sturdy with aesthetic appearance. Rack-Master maximizes barrel oxygen exposure by limiting barrel contact points, and Rack-Master polyethylene is 100% recyclable.

Snyder's offers poly Bulk Barrel, a proprietary design virtually impermeable to water and alcohol vapor, which eliminates leaking and routine topping, while allowing valuable oxygen molecules to permeate the vessel's sidewall. Bulk Barrel is available in 4-barrel (240 gallon), 5-barrel (300 gallon), and 6-barrel (360 gallon) capacities.

Sii SNYDER INDUSTRIES, INC.

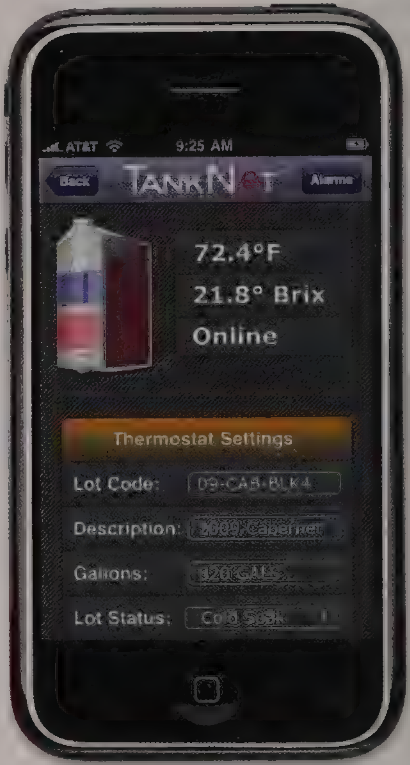
"Winetainer," includes a dimple heat transfer surface to facilitate targeted cooling objectives. Available in sizes from 120 to 790 gallons, with optional open-top style, and standard top fill or several manway door options.

For more information, contact:
Snyder Industries, Inc.
Jason Lenhoff, Product Manager
P.O. Box 4583, Lincoln, NE
tel: 402/467-5221; fax: 402/465-1220
e-mail: sales@snydernet.com
website: www.snydernet.com

PLEASE SEE SNYDER INDUSTRIES AD, PAGE 8.

ACROLON TECHNOLOGIES, INC.

For more than a decade, Acrolon's TankNET® systems have helped hundreds of wineries better manage fermentations, precisely control cellar environments, and conserve energy.



72.4°F
21.8° Brix
Online

Lot Code: 09-CAB-BLK4
Description: 2009 Cabernet
Gallons: 920 GALS
Lot Status: Cold Soak

TankNET® is an economical control platform for managing tank temperature, refrigeration equipment and cellar environments. The system requires no new wires at the tank, and can be accessed from any device via web browser. Principal features include calibration-free temperature control, effortless acquisition and web reporting of real-time fermentation data, brix/temp graphs, alarm notifications, dynamic "white-board" style tank charts, and more. Options for TankNET include an energy-conservation module, smart scheduler, automated pump-overs, continuous brix measurement, level detection, humidity/CO_2 control, and integration with third party production software and building systems.

For more information, contact:
Acrolon Technologies, Inc.
19201 Sonoma Hwy, Sonoma, CA 95476
tel: 707/938-1300; fax: 707/938-1342
e-mail: info@acrolon.com
website: www.acrolon.com

PLEASE SEE ACROLON TECHNOLOGIES AD, PAGE 69.

MIATECH INC.

Miatech is an industry leader providing innovative, cost-efficient, low maintenance solutions for the post-harvest industry.

One solution designed for wineries is Bio-Turbo, which eliminates airborne bacteria that can negatively influence wine's taste and prevents mold growth which can result in unpleasant odors. It will additionally create a better overall environment.

Bio-Turbo is environmentally safe, releasing clean, healthy air back into the atmosphere. It is also economically-friendly, with the added benefits of low power consumption and extremely easy maintenance.

Miatech also offers a range of wine barrel humidification solutions for storage areas. By maintaining optimal cellar humidity levels, Miatech systems can significantly reduce the amount of evaporation routinely occurring in wine barrels at rates up to four gallons/barrel/year. Costs of topping-off and additional wine needed are immediately reduced.

Miatech representatives are available for in-depth presentations on precisely how Miatech winery solutions can be custom tailored to suit a winery's exact needs.

For more information, contact:
Miatech Inc.
9480 SE Lawnfield Rd., Clackamas, OR 97015
tel: 503/659-5680; fax: 503/659-2204
e-mail: winery@miatech.org
website: www.miatech.org/winery

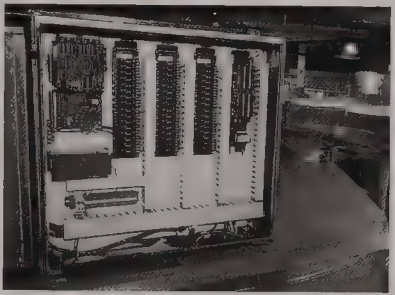
PLEASE SEE MIATECH AD, PAGE 13.

LOGIX

Logix Winery Control Systems (WCS) provide energy-efficient operation of refrigeration related equipment with documented savings in excess of 40%. The Logix WCS monitor and manage loads to minimize energy use, coordinating the demand and supply side of a winery's refrigeration system to provide cooling at the lowest possible energy consumption.

LOGIX

The Logix WCS is specifically designed for the demands of winery control applications, providing integration and control of wine tanks, compressors, chillers, air units, CO_2 monitoring/fresh air exchange, wastewater management, and more. Modular design of the Logix WCS provides easy expansion to cover additional equipment as a facility grows.



The Logix TC-2000 electronic thermostat with NEMA-4X waterproof enclosure provides stand-alone single- or two-stage cooling and/or heating control for wine tanks. The TC-2000s can be networked for integration with Logix Winery Control systems. All operating data and alarms are logged and available for plotting and reporting.

Logix has more than 20 years control system design / installation experience. Current wine installations include Turner Road Vintners, Chateau Ste. Michelle, Opus One, Columbia Crest, Franzia, Hogue Cellars, Novelty Hill - Januik, Woodbridge Winery, Silverado Vineyards, St. Francis, Swiftwater Cellars, and Starmont.

For more information, contact:
Logix
10518 NE 68th St, Ste 103, Kirkland, WA, 98033
tel: 425/828-4149; fax: 425/828-9682
e-mail: contact@logix-controls.com
website: www.logix-controls.com

PLEASE SEE LOGIX CONTROLS AD, PAGE 39.

BUCHER VASLIN NORTH AMERICA (KLR MACHINES, INC.)

KLR Machines Inc. has changed its name to Bucher Vaslin North America. The name change reflects the final stage in working under the internationally recognized brand of Bucher Vaslin.

Bucher Vaslin North America offers a complete line of Bucher Vaslin equipment, developed to accommodate all wineries. Ask about the Bucher XPlus line of presses, from 22 to 80 HL capacity. The ORGAN™, available on all XPlus models, is an extension of Bucher Vaslin's proprietary ORTAL™ software – providing perfect press extraction by winery needs and grape variety.

The Delta Vistalys® optical sorting line technology in 2011 includes sorting for white and red grapes, and a smaller model. The Delta Vistalys Optical Sorters allow wineries to control and increase quality, while improving overall efficiencies, for sorting at 2 to10 tons/hour.

The Delta and Bucher lines of equipment provide wineries high-quality, long-term reception equipment with an exceptional, dependable local parts and service department.

For further information, contact:
Bucher Vaslin North America
350 Morris St., Ste. E, Sebastopol, CA 94572
tel: 707/823-2883; fax: 707/823-6954
email: sales@bvnorthamerica.com
website: www.BVNorthAmerica.com

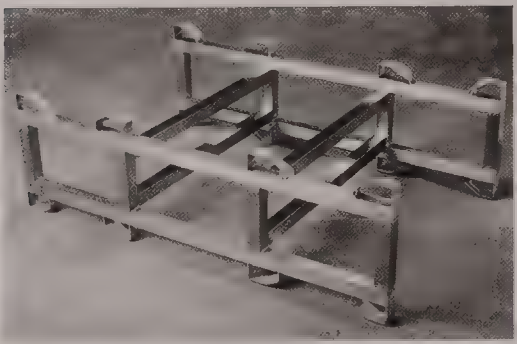
PLEASE SEE BUCHER VASLIN NORTH AMERICA AD, PAGE 98.

G.W. KENT, INC.

G.W. Kent has supplied wineries, breweries, and beverage industries since 1985. The company has a catalog and an online store with a full line of winery equipment and supply needs, including:

- destemming, crushing, and sorting equipment;
- refractometers and other testing instruments;
- bins;
- presses;
- tanks;
- valves;
- fittings;
- filters;
- pumps;
- gauges;
- corkers and fillers;
- corks;
- capsuling and labeling machines
- and more!

G.W. Kent stainless steel barrel racks have replaced many rusty metal barrel racks in wineries all over the U.S. In addition to offering racks that outshine the competition, G.W. Kent offers competitive prices and quick delivery from stock, or custom production. By reducing winery labor and maintenance costs, stainless steel racks are an investment that pays for itself in less than three years.



Shop for racks and much more. Order a catalog or shop online at gwkent.com.

For more information, contact:
G.W. Kent, Inc.
506 S. Huron, Ypsilanti, MI 48197
tel: 800/333-4288, or 734/572-1300
e-mail: info@gwkent.com
website: www.gwkent.com

PLEASE SEE G.W. KENT AD, PAGE 36.

SANITARY STAINLESS WELDING, INC

Sanitary Stainless Welding, Inc. manufactures custom fabricated storage and fermentation tanks for the wine industry. Tank size rangse from 250 gallons to 700,000 gallons.

Options include, but are not limited to:

- dimple jackets;
- channeled jackets;
- manways of various sizes;
- sample and racking ports;
- a variety of fittings and valves.

Tanks are offered with sloped or conical bottoms to sit on either metal or concrete bases. Tank tops include off-center, truncated or centered, conical tops.

Sanitary Stainless Welding, Inc. offers custom-design catwalks in either stainless steel or aluminum. The company also offers "tube in tube" heat exchangers, grape receiving hoppers, screw conveyors, tubing line installation, crusher repairs, press repairs, tank modification, and repairs.

Sanitary Stainless Welding, Inc. was founded in the original Valley Foundry facility in 2004, to be a premier tank construction solution.

For more information, contact:
Sanitary Stainless Welding, Inc.
2550 S. East Ave., Suite 101-B, Fresno, CA 93706
tel: 559/233-7116; fax: 559/233-7172
e-mail: jimm@sanitarystainless.com

PLEASE SEE SANITARY STAINLESS AD, PAGE 20.

RLS EQUIPMENT CO., INC.

RLS Equipment Company has provided wineries with quality equipment and service for more than 40 years. As agent for Kiesel, Amos, Strassburger, and Magitec, RLS can supply complete crushing and pressing systems.

Kiesel progressive-cavity pumps are available in hopper and in-line styles from 1,000 liters to 200+ tons per hour (tph). Unique Kiesel "corrugated" tube-in-tube heat exchangers can process from hundreds to thousands of gallons per hour, and save $$$ in energy costs.

Strassburger's MCC Crossflow Filtration system is a completely PLC-controlled unit that allows highly flexible control, and yields one of the lowest recirculation rates (less pumping of wine). Strassburger offers high-quality plate/frame and lees filters (S/S construction with either S/S or noryl plates are durable and easy to clean). A wide variety of filter pads is available.

The Magitec A-5 destemmer/crusher is designed for hand-sort/low volume. Magitec's unique square-hole basket is available from 2.5 tph to 60+ tph capacity. Magitec offers a variable-speed, dual-drive system (basket/beater bar) on small units, and split machines with vibrator sorting tables between destemming and crushing.

RLS offers a complete line of receiving and sorting equipment, and can easily supply a complete crushing system or "turn-key" winery.

RLS offers domestically-produced OEM-material, replacement membranes for most presses, and an extensive used equipment listing.

For more information, contact:
RLS Equipment Co., Inc.
1017 White Horse Pike, Egg Harbor, NJ 08215
tel: 609/965-0074,
or West Coast tel: 800/527-0197
fax: 609/965-2509
e-mail: rls.equip@att.net
website: www.rlsequipment.com

PLEASE SEE RLS EQUIPMENT AD, PAGE 32.

OGLETREE'S, INC.

For 65 years, Ogletree's has specialized in custom fabrication of winemaking equipment. By relying on the continual pursuit of innovation and the company's historical stability, Ogletree's is able to optimize value and quality to satisfy the wine industry's needs, while providing customers with the security that the job will be done right the first time.

Ogletree's manufactures high-quality hoists, receiving hoppers, belt and screw conveyors, sorting systems, bin dumpers, transfer lines, catwalk systems, and more. Ogletree's provides maintenance on all equipment offered.

Ogletree's has added two new bin dumpers to the product line. One uses a 110-volt linear actuator to dump, eliminating expensive, bulky hydraulic systems. It also features a gate to provide superior metering by holding grapes, releasing them in small amounts. Another bin dumper can be loaded by pallet jack or forklift, and is designed for direct-to-press feeding. It also can be upgraded to feed both doors of a two-door press.

Ogletree's years of service to the wine industry serves as a foundation to its design team, who design a superior product by collecting input from clients and focusing on specific needs. By utilizing solid quality-control procedures and a precise six-point inspection, Ogletree's team of experienced fabricators deliver products second-to-none.

For more information, contact:
Ogletree's, Inc.
935 Vintage Ave., St. Helena, CA 94574
tel: 707/963-3537; fax: 707/963-8217
e-mail: samp@ogletreecorp.com
website: www.ogletreecorp.com

PLEASE SEE OGLETREE'S AD, PAGE 41.

ARS/PRESSURE WASHER COMPANY

For the past six years, ARS has helped winemakers improve their cleaning, sanitization, and sterilization processes for barrel maintenance, tank cleaning, bottling line and general facility sanitization with the highly effective SWASH™ portable steam generator. ARS introduces the next generation SWASH™ steam generator – narrower, more maneuverable, more convenient to use, with improved safety features.

To make the SWASH™ system even more useful, ARS has expanded its line of accessories, offering a single or dual channel automatic timer that permits safe, overnight sterilization of a bottle filler and/or filter assembly.

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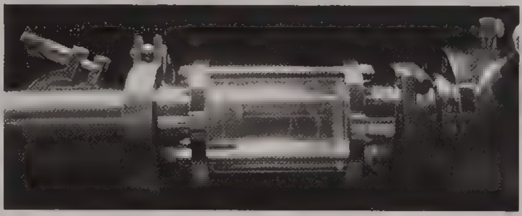

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PLEASE SEE ARS ENTERPRISES AD, PAGE 24.

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Berry temperatures: Correct measurement

BY Richard Smart

Grape berry temperatures are an increasing subject of discussion and articles in the wine business. This is understandable, as recent heat wave conditions have caused crop damage and loss of quality — in both California and Australia, for example.

For more than 30 years I have been concerned about the considerable confusion surrounding the proper measurement and interpretation of berry temperatures both in scientific and popular writings, and this column aims to set the record straight on this issue.

I studied for my PhD at Cornell University in New York in the early 1970s. I was attached to the U.S. Department of Agriculture microclimate project of the northeastern region U.S., and a major professor was the well-known crop microclimatologist Dr. Ed Lemon. I spent two years studying undergraduate mathematics and fluid dynamics in the School of Chemical Engineering.

While my thesis was on canopy microclimate effects on yield, I made a secondary study of the effects of the sun's heating on grape berry temperatures and also grapevine trunk temperatures. I shall not mention the latter anymore, except that this study provided an understanding of how the crown gall bacterium could so easily gain access to grapevine trunks in New York and other places with freezing winter temperatures and snow cover. Unbelievably, this was due to solar heating, and cracking of trunks, when sunlight was reflected from snow on the ground.

Our study of berry temperatures was published in the journal *Agricultural Meteorology* (1976), vol. 17, pp. 241–259: "Solar heating of grape berries and other spherical fruits" by R.E. Smart and T.R. Sinclair.

Grape berry temperature studies using energy balance

Initially the temperature of isolated grape berries exposed to sunlight was modeled and studied. An energy balance was constructed at the berry surface, in which the major components were energy absorbed from the sun, less the energy dissipated by convection (air movement) and heat conduction into the fruit. There are two other forms of energy loss, due to long wave radiation emission and by transpirational cooling, but these were both found to be minor components. (See Figure 1.)

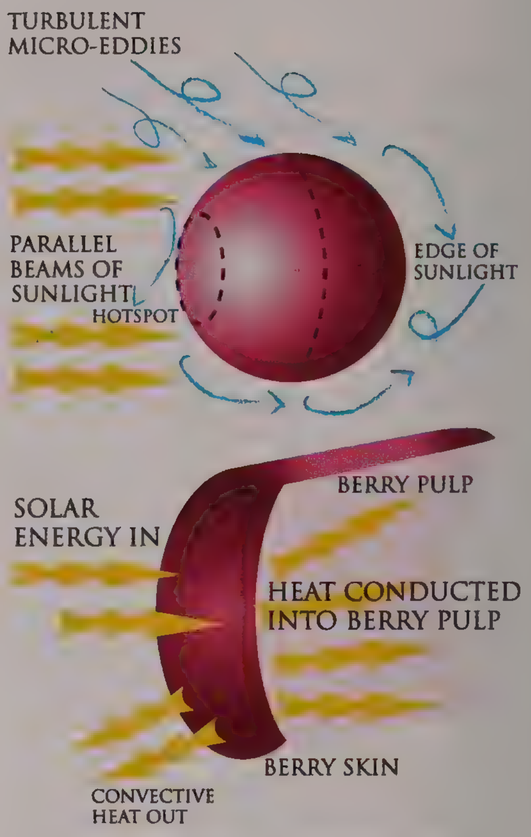

Figure 1. Schematic of a single berry in a field of parallel beam sunlight which illuminates half the sphere. Also indicated are turbulent micro-eddies of wind. The "hotspot" is at the point of maximum sunlight intensity, where the beam is normal to the berry surface. Also shown below is the energy balance for a slice of the berry. Dominating terms are absorbed sunlight at the skin, heat convected away by the wind, and heat conducted into the berry from the skin. [Figures 1 and 2 created and provided by *Australia & New Zealand Wine Industry Journal*.]

When a sphere such as a grape berry is exposed to parallel beams of direct sunlight, there is always some part of the sphere's surface at right angles to the sun's beams. This forms the so-called "hotspot" and the temperature here will

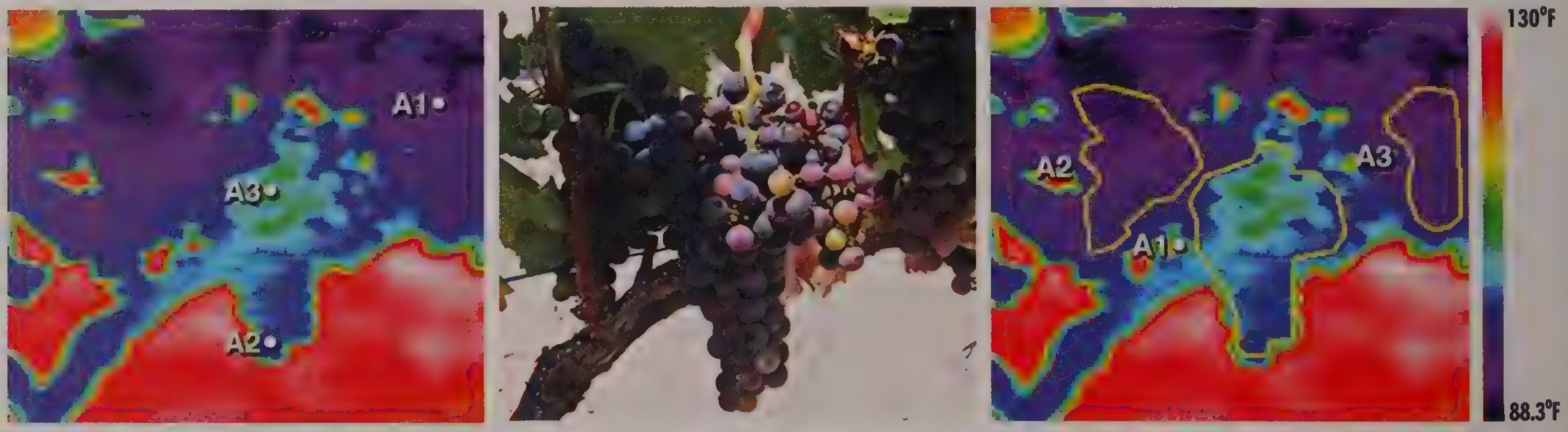

Figure 3. Two thermal images of Castelão grape clusters (Portugal). See temperature scale at right. With an air temperature of 82.4°F, the cluster temperature was up to 53.6°F above ambient. Furthermore, temperature of single berries were up to 59°F higher than the air temperature. Note that "cluster temperature" is a complex issue, and not a simple number! Note how hot the soil underneath grapes is! (This figure is from a study by Stoll and Jones, *Vigne du Vin*, 2007.)

be the hottest on the berry because of receiving maximum intensity of sunlight. Since black berries absorb more sunlight than white berries (around 22%), they will heat more when exposed to otherwise similar conditions.

In the natural environment of a vineyard, airflow (wind) is turbulent. Forced convection is due to local wind speed around the berry, and the angle of the wind also affects the local heat transfer coefficient at the surface.

The other major form of heat loss from the surface of the berry is that of conduction of heat **into** the berry. In turn, one can assume that the thermal conductivity of a berry is a function of the sugar content, which is slightly lower than that of water for sugar content (at maturity).

Modeling studies

I found (in the literature), solutions to the energy balance equation, but they were complex and difficult to use. We simplified these models to allow prediction of berry temperature at the hotspot, at the back of the berry opposite the hotspot, and also at the center of the berry. These equations were verified by temperature studies of irradiated single berries in a laboratory.

These studies showed that temperatures were **higher** for larger berries, black berries, low wind speeds, and when the sun and wind directions were at about 90° to each other. Temperature increases of over 31°F above ambient temperatures at the hotspot were found. The temperature gradient from the hotspot to the center of berries was highest at low wind speed, and varied from 9°F to 34°F.

Studies of berries in clusters

These studies were done in a wind tunnel and compared a compact Riesling cluster with a loose Concord cluster. In a tight cluster, the wind can only take heat away from part of the cluster surface which is exposed to the wind. In tight clusters, heat will be conducted berry to berry across the cluster, from the sun heated side to that In the shadow. Obviously, this conduction will be higher in the absence of air filled cavities between berries.

Further, a compact cluster acts like a "bluff" body, equivalent to a larger berry, so it has reduced rates of convective heat transfer. On the other hand, in a loose Concord cluster, each berry surface can be affected by wind and perhaps the sun, and there is virtually no berry-to-berry heat transfer. (See Figure 2.)

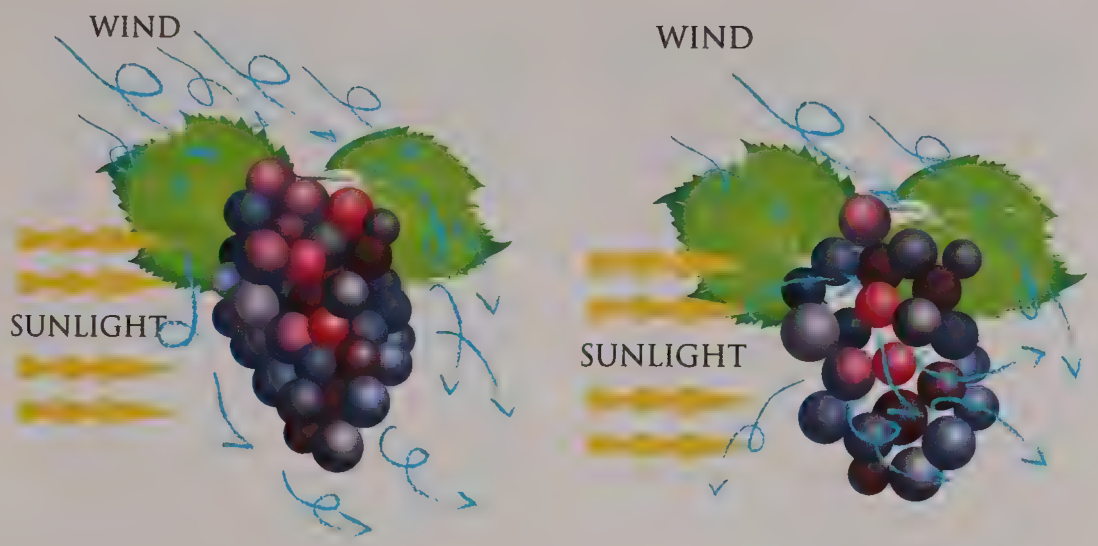

Figure 2. Schematic shows that wind passes around a compact grape cluster, and can be around individual berries in a loose one. Further, since berries are pressed against each other in a tight cluster, there is good conduction of heat across the cluster. In a loose cluster, more berries may be illuminated, and wind may pass around each berry.

Wind tunnel studies clearly demonstrated that heat was conducted from berry to berry in a compact Riesling cluster. At a low wind velocity of 0.5 meters per second (m/s), the center berry temperature gradient was from 25°F above air temperature on the exposed side, to 9°F above in the middle, and 5°F in a berry center at the back of the cluster.

Exposed to altered conditions, such as an increase in air temperature, one needs to consider the time required to reach a new steady state, described by "time constants."

A time constant for temperature is the time required to come to 63% of the equilibrium value under steady-state conditions. Sunlight intensity and interception, air temperature, and wind velocity and direction can all change from minute to minute in the vineyard. Wind velocity and direction are particularly variable.

Time constants will be all important in determining berry temperatures in the vineyard. Time constants were studied for isolated Concord berries and were smaller at high wind velocities. The hotspot time constant at 1 m/s wind velocity was about three minutes, and over five minutes at the berry center.

Longer time constants were found in cluster studies. For example, for the berry center of Riesling berries on a compact cluster and exposed to the sun, the time constant is 16.5 minutes at 0.6 m/s wind velocity. The value is 34 minutes at the cluster center and 40 minutes at the cluster back side. These are very high values considering how quickly sunshine and wind change in the vineyard. The implication here is that different parts of the cluster will lag behind air temperature changes, and changes due to sun and wind.

Field berry temperatures were also measured on an unusually hot day (August 1, 1975) at Hector, NY. The Concord berries were pre-veraison. Air temperature over the measurement period was around 88°F, and shade berry surface temperatures were 4°F higher at around 92°F. This can be because of some limited or prior sun exposure, and elevated air temperature in the canopy if it was not well ventilated.

The hotspot temperature for a tight cluster was 113°F, and 109°F for a loose cluster. The back of a sunlit cluster was around 102°F. Black ink was applied to a green berry, and temperature rose from 19°F above air temperature to +29°F with a changed color!

Variability of berry temperatures in the vineyard

I recently published a similar article to this in Australia that elicited a response from a German colleague, Manfred

Stoll. His research has involved thermal imaging of grape clusters, and Figure 3 shows the variability in berry temperatures on a cluster very clearly. Stoll welcomed my comments that "bunch temperature" is a very complex phenomenon, and not easy to measure!

Caution with berry temperature measurements

Several issues about berry temperature measurement arise from my studies:

- Highest berry temperatures are found in the "hotspot" of large, black berries in compact clusters, with bright sunlight and low winds. These climate conditions can change in minutes.
- Exposed berries can heat very quickly at the surface, and also in the flesh.
- Berries at the top of a canopy (as in the GDC training system) can receive high intensity sunlight most of the day.
- The ratio of leaf area to cluster area at the canopy surface will affect cluster exposure and thus the potential for solar heating.
- Berry-to-berry heat conduction is important for compact clusters.

There is normally not a single "cluster" temperature in the field, but rather a range of temperatures of different parts of different berries. Measurements in the center of clusters as have been made in Australian research studies are impossible to interpret, as they will be affected by cluster compactness, change of climate conditions, and time constants.

Cluster temperatures vary depending on whether the cluster is in sunlight or in shade, and how long it has been in the sunlight.

Particular care should be taken in assuming that an exposed data logger temperature relates to cluster temperatures in the field. First, exposure and shading in the fruit zone is very complex and frequently changing that would require many data loggers to accurately assess exposure. Second, the data logger can have a different shape, size, and color (albedo) than a grape cluster, and the larger ones are air-filled, of very different thermal conductivity to grape berry contents.

Care must be taken when attaching temperature measuring devices to, for example, vineyard posts, which will have very different properties and sizes in relation to solar heating, convection, and thermal transmission than grape clusters. Heating of the post can obviously affect data logger temperature.

Care should be taken with infrared thermometers. They need frequent calibration, and measurements must be taken with due regard to the "field of view" of the instrument. Some sensors may see a few square millimeters, so just a "hotspot." Others may see all of the illuminated surface of the berry, which is a lower average value. Beware of shading the surface being measured.

Conclusion

Measurement of berry temperature in the field is very difficult to do and to interpret. Meaningful measurements of fruit temperature in a vineyard need to allow for the proportion of the fruit exposed, cluster color and compactness, and exposure of the fruit as a function of time of day and of solar position. Wind velocity and direction should also be measured. **There is no one single cluster temperature!**

This column attempts to introduce more rigor into the scientific and commercial measurement of berry and "cluster" temperatures. Hotspot temperatures can be 31°F or so more than air temperature, so on hot days berry temperatures can exceed 130°F easily, with significant effects on berry tissues and physiological processes. ■

Dr. Richard Smart is rewriting and thoroughly revising Sunlight into Wine. *He is happy to receive statements from growers and winemakers about their commercial success with various aspects of canopy management. Interested persons should contact Dr. Smart by email at richard@smartvit.com.au. Dr. Smart visits the U.S. frequently, and consulting appointments can be made by email. See also www.smartvit.com.au*

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New UC Davis Winery

Continued from page 84.

and quality. "Our working volume is 140 liters of red must that presses out to between ⅓ and ½ of a 225-L oak barrel," explains Chik Brenneman, winery manager. "We can ferment 40 gallons of white grape juice."

The newly designed fermentation sensors extract and transmit sugar-concentration data from white and red fermentations across a secure wireless network The data can be generated every 15 minutes with a precision of 0.25° Brix. "The creation of these sensors involved applying complex mathematical procedures and the latest radio frequency technology," explains Roger Boulton (winery engineering expert and Stephen Sinclair Scott Endowed Chair in Enology).

Carbon dioxide (a natural byproduct of fermentation), is sequestered from a port in each fermentor. An innovative process will remove the carbon dioxide (CO_2) from the winery, reducing the building's energy requirements for air quality and temperature control. Plans call for eventually converting CO_2 to calcium carbonate for reuse in winemaking, preventing contribution to global warming. "The goal is for the facility to be not just carbon neutral, but carbon zero, in terms of its carbon emissions," adds Boulton.

David Block (biochemical engineer and Department of Viticulture & Enology vice chair), notes, "The new fermentation system and adjacent controlled-temperature rooms will enable scientists and students to conduct high-precision winemaking studies and probe how different variables such as grape growing practices, vineyard location, and choice of yeast strains impact the character and quality of wines. No other viticulture and enology research organization has a facility with these capabilities."

Donors make vision a reality

Private donors contributed funds beginning with $5 million in 2001 from the late winemaker Robert Mondavi. Other major donors include Ronald and Diane Miller and a group of winery partners led by Jess Jackson and his wife Barbara Banke (Kendall-Jackson Wines), and Jerry Lohr (J. Lohr Vineyards & Wines) to secure funds needed to design and construct the facility.

More than 150 alumni, corporations, foundations, and individuals contributed funds to make the winery, brewery, and food-processing complex a reality; including major contributors from the Department of Viticulture & Enology's Board of Visitors and Fellows.

KLR Machines donated nine pieces of equipment in 2008–2010 in a three-year agreement, continuing a relationship between UC Davis and KLR Machines that began in 1984 with donation of a Bucher model RPL 36 tank press. In 2010, donated Bucher Vaslin equipment included a TRV 35 vibrating sorting table (3.5 meters long) and two sets of Delta crusher-rollers (F20 for crushing after sorting on the TRV 35, F2 for crushing under the Delta E2 destemmer).

In 2009, KLR donations included a Bucher Xplus 22HL tank press (with 12 modifiable programs), a Delta PM 2- positive displacement helicoidal must pump (variable speed and level sensor), and a Delta TRV 20 – vibrating receiving hopper. A Costral Bottling semi-automatic 14-spout rotary filler and corker/screw-capper was donated that year.

In 2008, KLR donations included a Delta E2 Destemmer with variable speed drive for hand or machine-picked grapes and special high-density polyethylene cage of varying hole sizes, a 22HL Bucher XPF tank press, and Delta TR 300 incline conveyor (VFD height of three meters).

The laboratory includes a $100,000 donation of Thermo-Fisher lab equipment to support all basic analyses necessary for winemaking. (TA, pH, VA, RS, SO_2, etc.). Filtrox donated a 40cm x 40cm plate+frame filter with cross-over plate and Meissner donated a 30-inch T-line cartridge filter.

COOPERAGES 1912 BARREL ROOM – For the winery's first vintage, UC Davis and Cooperages 1912 created a versatile real-world scenario for different wine varieties and winemaking styles.

"It is important for UC Davis to create a foundation from which we can build custom T.W. Boswell and World Cooperage barrel programs," says Chik Brenneman. "For this reason, we are starting with traditional toasting styles and an even split of French and American oak."

Cooperages 1912 donated 20, 225-liter barrels for the 2010 vintage. To simulate a working winery situation, UC Davis supplemented these with 5-year-old barrels formerly used to age Chardonnay. Each year, UC Davis will partner with Cooperages 1912's research team to develop custom barrel profiles and conduct joint research.

"This barrel program reflects a typical winery scenario, with wine being placed in a variety of wood types, toasts, and barrel ages to later create a balanced blend," says David Llodrá, Cooperages 1912 research director.

Invite for donations

The Department of Viticulture & Enology needs $6 million to $7 million in private donations for an auxiliary building to include equipment to filter rainwater for reuse. ■

More information about the department and the new winery is available online at http://wineserver.ucdavis.edu.

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QUALITIES of a GREAT TASTING ROOM MANAGER

BY Craig Root

Tasting rooms and wine clubs represent the largest source of revenue for many small and medium-size wineries. In essence, the tasting room is a winery's first-place distributor — therefore the tasting room manager is president of that distributorship. When you put the manager's job in perspective like this, it puts much more emphasis on the position.

I frequently see tasting rooms in a situation where the current manager is leaving, and higher management automatically picks the weekend manager as the replacement without any deliberation. If you found out that your first-place distributor was that cavalier about selecting a president, you would be livid. Yet the winery owns the first-place distributor. Maybe the weekend manager *is* the person, but do a proper personnel search for that very important position.

The tasting room manager position is one of the most difficult and tricky jobs in a winery operation. Why is this? In many tasting rooms (I would suggest the majority), the staff is comprised of people who are not dependent on their pay. They enjoy it and spend it, but they are not going to lose their homes if they lose their jobs.

Furthermore, you want lively, upbeat folks to work with the public, so they are far from placid and probably pretty independent. Therefore, the manager is trying to lead and motivate a group of employees who do not need the money and are more volatile than other staff. As an ex-manager, I can tell you that this can be an extremely challenging task.

Having set the stage, let me list a few of the categories in which a manager must excel. By the way, it is a given that a manager has to possess superior brand and wine knowledge. This article also presupposes that great managers understand the perils of understaffing (discussed in ***PWV***, January/February 2010, "Tasting Room Fallacies").

- **Finance** – As president of your largest distributor, tasting room managers have to have an appreciation of income and expenses. One of the faults I see with many managers is that they are more aware of gross rather than net. An attribute of the great manager is a keen look at the bottom line. If you make $1,000 and after you pay all the bills you get to keep $10, or you make $500 and after the bills you get to keep $100, which scenario are you going to choose? Clearly, the second.

A good manager can create his or her own budget, adhere to it, and return 15% to 30% net on tasting room sales and a margin of 30% to 50% on wine club sales. You have to have over five years of operation to achieve margins like this.

- **Flexibility** – You have a challenging work force. One of the ways to keep them and motivate them is with flexible scheduling. That homemaker who needs to leave a half-hour early one day each week to pick up her child at soccer, let her go. A key employee who has not had a family reunion in many years and wants to have the July Fourth weekend off to attend that long-awaited reunion, let him go even if you have to employ a temporary. The worst managers are rigid; the best are judiciously flexible.
- **Facility management** – Staying on top of janitorial, grounds-keeping, wear and tear, and overall cleanliness, especially in rest rooms, is an important but little recognized attribute of a good manager. Customers are judging you by the appearance of your facility. That is why, for example, as a manager I would always make sure the gardener received a bottle of wine on a regular basis.
- **Wine club knowledge** – This is a huge part of a tasting room budget. Good managers work closely with the club manager, and are acutely aware of retention, attrition, club events and their budgets, club communication, and club operations. These are just a few of the areas of concern.
- **Tours** – Many wineries have the ability to do tours but do not, because the manager does not understand that tours increase sales, wine club sign-ups, and positive memories of your winery. An attribute of a good manager is an eagerness to create and implement regular tours, which entertain and educate the consumer about the winery and its wines.
- **Psychology** – Remember that we are dealing with a challenging work force. For example, I find that there are two times when morale can get low: in October because of burnout toward the end of the busy season, and in February because the staff is experiencing "cabin fever"— stuck indoors with too few customers — which can create friction among some staff. Smart psychologist-managers throw a staff appreciation dinner in the middle of October. Or they send select staff on mystery shops at other tasting rooms during February or March.

Many wineries are family-owned; being a bit of a psychologist is particularly helpful. If there is any friction between Mom, Dad, and the various siblings, a tasting room manager needs to understand how to navigate harmoniously within those rocky waters. When possible, a smart manager stays neutral in that situation, and just focuses on profits rather than taking sides.

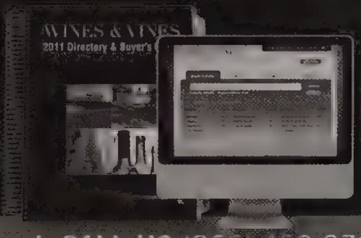
- **Knowledge of the competition –** Speaking of mystery shops, a good manager is well aware of who is performing well at competing wineries, constantly striving to be a leader, not a follower. When you are interviewing for the tasting room manager position, that is a good question to ask candidates: "Which wineries are doing a great job with their tasting rooms and why?"
- **Leadership –** The ability to inspire people to follow you is critical. To inspire your staff, many of whom are only earning $10 to $14 per hour, takes leadership. Sometimes it is the little managerial things, such as working on the weekends (or at least one weekend day per week), or never leaving an event until it is over. Sometimes it is a matter of clear communication — making sure the staff knows **why** you want to institute a new policy or procedure.
- **Trade relations –** For many wineries with broad distribution, as much as 10% to 20% of the tasting room energy per year is spent taking care of buyers, sales reps, and VIPs of every type. I believe this is one of a tasting room's unsung and important duties — despite the fact that with all that staff and management time, it accrues zero dollars. The winery makes money because of increased placements or sales that result from a successful trade visit; the tasting room receives nothing.

Astute managers know how to assign just the right staff person to handle individual trade visitors or whether to handle the visit themselves. For example, if the trade visitor is from New York and the manager knows that a top staff person used to live in New York, that assignment will be a good fit.

- **Strategic –** Good managers need to be strategic in their thinking, always looking over the horizon for new and better ideas, while at the same time being able to bear up under poor years. For example, everybody is moaning about the economic downturn, and rightfully so. But please remember that we had the dot.com bust that hurt tasting room sales followed by 9/11, which also impacted tourism and tasting room sales.

Great tasting room managers need to always be prepared for unexpected business downturns, while maintaining control of all the other aspects of their management tasks and assuring the tasting room provides a positive experience for visitors. ■

With 30 years of experience in winery tasting rooms, Craig Root teaches Tasting Room Design and Management at UC Davis and spends the first Saturday of every month working in a busy winery tasting room, averaging one wine club sign-up and two tours per shift. Visit: www.craigroot.com



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WINES & VINES

Grape/Wine marketing – Continued from page 77

Sauvignon and Sauvignon Blanc. We begged to swap the Sauvignon Blanc for Chardonnay, but they would not do it. It came back to hurt them.

Fortunately, by understanding the trend, at J. Lohr I created new wines and managed the rest of our portfolio from 44,000 cases annually to just under one-half million cases annually when I left in 1993.

The market swings on a dime. I sold a program to the Hyatt Hotels in the 1980s. We were selling 10-1 white to red wine. White wine was the new "cocktail," although wine consumption was declining steadily. The two-martini lunch was out; health and fitness was in. Neo-prohibitionists were having some influence on the public; as was Mothers Against Drunk Driving. The drunk driving threshold dropped from 1.0 to 0.08.

During my plane trips at that time, if the person sitting next to me asked, "What do you do for a living?" and I replied, "I am in the wine business," the reaction would be "Uh, Stewardess, can I move to another seat please?" Many of my colleagues were leaving the business to open up yogurt parlors so they did not feel like drug dealers.

Then, suddenly, *60 Minutes* broadcast a story on the French Paradox. In one year, we went from selling 10-1 White to Red to a 1:1 ratio. Consumption started increasing. Now, if I am on a flight and mention I am in the wine business, the passenger next to me is delighted, and launches into some wine experience.

Read more of this informative speech at www.practicalwinery.com!

HAHN FAMILY WINES TRIAL WITH HELLO VINO

In November 2010, Hahn Family Wines began a Hello Vino trial in three states — California, New Jersey, and New York — to support off-premise wine sales of Cycles Gladiator 2008 Cabernet Sauvignon, Hahn Santa Lucia Highlands 2009 Chardonnay, Hahn Monterey County 2009 Pinot Noir, and Smith & Hook 2007 Cabernet Sauvignon. The trial began November 17, producing significantly positive results for the four wines promoted.

During the first half of the month, November 1–16, the brands received 852 impressions from mobile devices as recommendations to potential buyers. The second half of the month, after the trial began, brought 4,199 impressions, an increase of 500%. Click-throughs, which measure consumer interest to obtain more information (review, tasting notes, where to purchase) and indicate great buyer interest and a greater likelihood of purchase, improved from 5.4% to 9% during the same period.

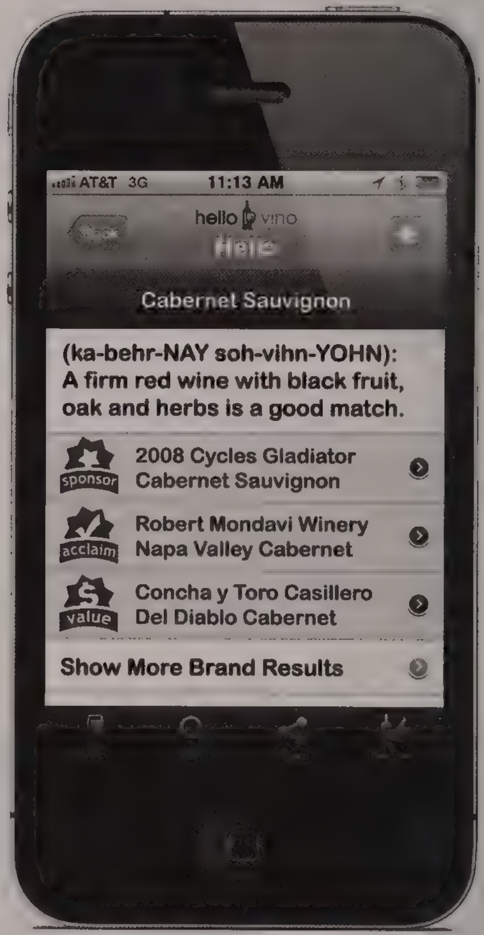
"These could be very valuable impressions and clicks since, as opposed to a banner ad on a website, the consumer is actively trying to find a wine to fit a particular need and is searching for information," explains Joshua Cairns, Hahn Family Wines webmaster and Direct Sales Manager. "These impressions will become even more beneficial when Hello Vino launches its retail connection in 2011 and consumers will be able to search for wine that is available in the store they are currently in. We are excited to work with Hello Vino and put our ad dollars into this project."

"Hello Vino is the first mobile application that offers users a simple, fast, and relevant wine recommendation at the point of purchase," says Jim Kopp, VP strategic development for Hello Vino, "allowing wineries to promote to consumers who are seeking a specific style of wine for their intended meal or occasion. This is a significant leap forward for wineries that have relied on the passive effects of shelf talkers and back cards to entice would-be buyers."

Further reinforcement of this concept was made at a recent marketing seminar when Gretchen Scheiman, Director of CRM at Ogilvy Worldwide, stated: "In Christmas 2010, the mobile channel will drive more in-store activity than even salespeople. If [consumers] can get access to reviews and all the data that is out there that is more trusted than salespeople, they are going to turn to mobile."

Hahn Family Wines clearly understands this shift in consumer behavior, having been leaders in the digital marketing of wines since 2006. Their efforts in merchandising wines through web and mobile devices have made them a winery to watch within the industry at large and resulted in strong consumer support for their various brands.

"I believe this is the most exciting time in the 37 years I have been in the wine industry," adds Bill Leigon. "We are taking the newest technology and applying it to a very old idea – wine is best sold 'word of mouth' by one person to one person one at a time. We can now do that on an international scale."



(ka-behr-NAY soh-vihn-YOHN): A firm red wine with black fruit, oak and herbs is a good match.

- sponsor — 2008 Cycles Gladiator Cabernet Sauvignon
- acclaim — Robert Mondavi Winery Napa Valley Cabernet
- value — Concha y Toro Casillero Del Diablo Cabernet

Show More Brand Results

hello
vino

Wine pricing

Continued from page 82

For example, Ackerman Family Vineyards (Napa, CA) used this channel very effectively during the recession with no discounting, due to excellent relationships with high-end wine shops and specialty restaurants. Shipping was outsourced to UPS and Fed-EX, as most shipments are small. Small wineries can work together to expand this channel and build new relationships.

7) Staying flexible and innovative to new trends and opportunities is especially important during economic downtimes. Interestingly, each crisis often leads to a new breakthrough wine concept for a wine business that is open to new ideas and is fast enough to respond.

For example, during the last downturn, the category of super-value wine was launched with the Charles Shaw "Two Buck Chuck" brand. During this cycle, new business models are also being developed, such as Cameron Hughes brand, which purchases quality wine from high-end wineries at discounted prices, guaranteeing anonymity to the winery. The wine is bottled under the Cameron Hughes label, often garnering top ratings from critics, and sold at prices that make consumers feel they are getting a high-quality wine at a great deal. Staying flexible, tracking consumer trends, and being innovative is always an excellent solution during good and bad times.

An industry solution for the future: Wine Industry Pricing Model

Nearly every industry has adopted some type of formal pricing models. The wine industry, however, has been reluctant — relying instead on ad hoc pricing methods. While lowering prices and increasing promotion seems easy enough, questions still abound. How much should you lower price? When should you promote? What price reduction should accompany your promotion? If my competitor lowers their price, what happens to my sales? These are just a few of the questions that formal pricing models can answer.

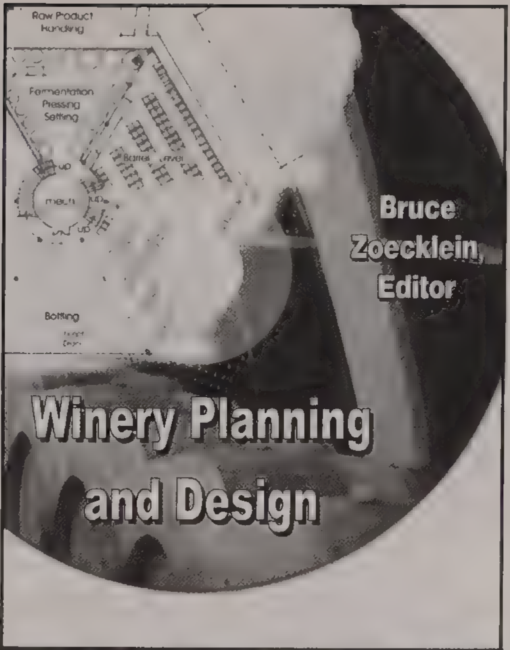
A pricing model is a theoretical construct that allows you to calculate the impact of pricing changes on sales and revenue in a variety of contexts, including seasonal factors, competitor actions, and geographic areas. Formal pricing models are becoming increasingly common in nearly every industry from clothing to consumer package goods and have been used for years by the airlines.

Without a formal pricing model, setting prices too low may result in shortages at the retailer, leading some consumers to instead buy competing products, which may damage brand equity. Prices set too high result in lost sales to more reasonably priced competing products. This usually leads to a buildup of retail inventories, leading to either prices being arbitrarily cut by the retailer or shipments being sent back to the distributor, which may then mean greater costs to the winery in the form of increased depletion allowances.

Adopting formal pricing models requires a conscious decision to move in that direction. In industries where product differentiation exists (like wine), formal pricing models are developed at the firm level, either internally or externally by outside consultants who specialize in pricing strategies.

A good pricing model needs to start with a question about consumer behavior: "How do wine consumers make purchasing decisions?" Next, relevant data is collected on the variables affecting wine purchases. The theoretical model is then estimated using econometric or statistical software, such as SAS, SPSS, or Stata.

Clearly, pricing is perhaps the single most important factor in determining the profitability of a winery. While wineries cannot set prices for their wines, formal pricing models can help wineries work with distributors and retailers to recommend prices that improve profitability and increase efficiency throughout the supply chain. ■



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FEBRUARY 17-19

MGGA COLD CLIMATE GRAPE AND WINE CONFERENCE SHERATON BLOOMINGTON HOTEL

BLOOMINGTON, MN

The largest grape and wine industry trade show in the upper Midwest offers three tracks of comprehensive educational sessions (viticulture, enology, and marketing/management), all-day "Starting your Winery Successfully: Step by Step" workshop led by winemaking consultant, Tom Payette (and more presenters), keynote addresses by Nick Ferrante: "Ferrante Winery, Professionalism and Profits," and Kent Gustafson (University of Minnesota): "Wineries, Vineyards, and Agro-Tourism: a Win-Win Situation," plus networking opportunities.

Sessions include, but not limited to:

Enology sessions: Fruit and Juice Quality Issues Pre-Fermentation; Katie Cook (Univ. of Minnesota [UoM]) • What you need for Healthy Fermentations; Michael Jones (Scott Labs) • Oak Barrel Alternatives; Steve Menke (Colorado State Univ. [CSU) • Rose Processing using Cold Climate Reds; Katie Cook (UoM) • Wine Tasting 101; Richard Leahy (consultant) • Identifying, Avoiding, and Treating Common Wine Flaws; Dr. Anna Katharine Mansfield (Cornell Univ.), Dr. Murli Dharmadhikari (Iowa State Univ.) • Review of 2010 International Cold Climate Wine Competition results by panel of judges and winning winemakers • Winemakers Roundtable – Art of the Blend, Old World Models, Cold Climate White Blends, Cold Climate Red Blends; Steve Menke (CSU), Pat Howe [ETS Labs] • Red and White Ice Wine Production; Nick Ferrante (Ferrante Winery, OH) • Planning for Wine Quality; Pat Howe.

Viticulture sessions: Site Selection in Cold Climates and GIS as an aid; Mark Hart (Mount Ashwabay Vineyard [MAV] WI), Peter Hemstad (UoM) • Site Preparation #1: Matching Site, Cultivar, and Training System; John Thull (UoM) • Site Preparation #2: Young Vineyard Care; Dr. Paolo Sabbatini (Michigan State Univ. [MSU]) • What does it take to grow and get paid for top-quality grapes and responding to seasonal variations; Peter Hemstad (UoM), Chris Granstrom (Lincoln Peak Vineyard & Winery, VT), Randall Vos (Des Moines Area Community College [DMACC]) • Crop Estimation and Dormant Pruning (video and workshop); Dr. Paolo Sabbatini (MSU), Randall Vos (DMACC] • Bird Netting options • Viticulture Problem Clinic; Mark Hart (MAV), Dr. Cliff Ohmart (Sure Harvest, CA), Dimitre Mollov (UoM) • Understanding Fruit Chemistry and impact on Fruit Quality and Measuring Fruit Quality Parameters and Harvest Timing: Katie Cook (UoM), Peter Hemstad (UoM) • Summary of the Cold Climate Viticulture Grant; Dr. Jim Luby (UoM) • Sustainability and IPM; Dr. Cliff Ohmart (Sure Harvest, CA) • Fungal Disease Management (materials, schedules, economics) and Canopy Management for Disease Control; Dr. Mike Ellis (Ohio State Univ.).

Marketing and Management: TTB Workshop – Guide to Online Label Approval, Online Tax Payment and Compliance, Bioterrorism Compliance • Join the Locavore movement – Eat and Drink Local • Understanding and Using Social Media Networking; Brad Johnson (Winedustry, IA) • Virtual Tour of Tasting Rooms; Patty Held (Patty Held Winery Consulting) • From Business Plan to Market Success (Business plan, Marketing plan, and Successful Examples); Patty Held, Brad Johnson (Winedustry, IA), Elizabeth Slater (In Short Direct Marketing, CA) • Impressive Winery Website Design; Ben Banks (Sovereign Fine Art and Photography) • Keys to a Successful Tasting Room; Patty Held, Elizabeth Slater.

For more information, visit the Minnesota Grape Growers Association website or on Facebook: MGGA Cold Climate Grape and Wine Conference. For general conference inquiries, contact: Lisa Smiley (lisa.smiley@mngrapes.org) or 651-492-5393. To become an exhibitor or sponsor, contact Bob Mignarri at: bob@qemonline.com or 401-885-8788 extension 11.

FEBRUARY 22-25

AGSAFE CONFERENCE HYATT REGENCY MONTEREY HOTEL & SPA

MONTEREY, CA

17th Annual AgSafe Conference will address safety needs of wineries/vineyards with a premier safety, health, and human resources education and networking conference including nearly 100 seminars in English/Spanish. Dr. John Howard, Director of the National Institute of Occupational Safety & Health (NIOSH), is February 23 Keynote Speaker to address safety and health priorities for the Barack Obama administration.

The Conference features courses on sulfur dioxide safety in the cellar, an update from NIOSH on ergonomic winegrape harvesting bins, and minimizing worker sprains and strains for California's winegrape growers and wineries.

The Conference will include: A Trade Show featuring the latest safety, health and human resources products and services; Train-the-Trainer courses for forklift, tractor, ATV, and respirator-fit-testing; Continuing Education Units for Farm Labor Contractors, Pest Control Advisors, Certified Safety Professionals, and Professionals in Human Resources.

The California Safety Certificate Program that provides a fundamental education in developing, establishing, and maintaining a safety program for agricultural operations (recently featured in the *Journal of Agromedicine*), has nearly 600 graduates and will be offered in both Spanish/English.

AgSafe is a nonprofit statewide organization, founded in 1991, comprised of individuals, associations, and businesses with the shared mission of preventing injuries, illness, and fatalities among those working in agriculture. The primary goal is to provide employers with the tools they need to keep employees safe and healthy while running a profitable, successful business.

For more information or to register for the 2011 AgSafe Conference, visit www.agsafe.org or call 209-526-4400.

March 17
Recent Advances in Viticulture and Enology (RAVE)

Freeborn Hall, UC Davis

Overviews of the latest research on the microbes of wine and provide insights into astute management practices. Exploitation of microbial populations and their behavior is crucial to successful winemaking.

TIME: 8:30 AM - 5 PM **COST:** $220 For more information, visit www.extension.ucdavis.edu/wine

March 29 - 30
International Wine Microbiology Symposium

Tenaya Lodge, Yosemite, CA

Second International Wine Microbiology Symposium (presented by California State University, Fresno Viticulture & Enology Program, with support from several industry sponsors) will feature national and international experts from five continents. Members of the wine industry – including winemakers and laboratory personnel –will not want to miss this event at the beautiful Tenaya Lodge at Yosemite resort. Register early by February 20 and save! The Tenaya Lodge offers a special discount to Wine Microbiology Symposium attendees.

Presentations include:

Retrospect – Professor Ken Fugelsang (CSU, Fresno)

Problems & Solutions – Dr. Robert Tracy (BevTrak), Dr. Susan Rodriguez (CSU Fresno), Dr. Rich Descenzo (ETS Laboratories)

New Yeasts From Old – Dr. Roy Thornton (CSU Fresno), Lida Malandra (Anchor Yeast, South Africa), Dr. Maryam Ehsani (Laffort, France)

Yeasts, Wine Styles & Quality – Dr. Chandra Richter (E&J Gallo Winery), Dr. Hennie van Vuuren (University of British Columbia, Canada), Nathalie Sieczkowski (R&D Lallemand, France)

Microbial Metabolism Still Calls the Shots – Dr. Linda Bisson (UC Davis), Lars Peterson (Gusmer Enterprises), Dr. Eduardo Agosin, (Universidad Catolica de Chile, Chile), Dr. Charles Edwards (Washington State Univ.)

Malolactic Fermentation – Dr. Mareth du Toit (Stellenbosch Univ., South Africa), Magali Déléris-Bou (R&D Lallemand), Dr. Nichola Hall (Scott Labs), Dr. Hentie Swiegers (Chr-Hansen)

Microbial Ecology – Dr. Patrizia Romano (Univ. of Potenza, Italy), Dr. Sergi Ferrer (Univ. of Valencia, Spain), Dr. Matthew Goddard (Auckland University, New Zealand), Dr. Chris Curtin (The Australian Wine Research Institute)

PANEL: **Winemakers' Wish List**

Wine Microbiology Prospects – Dr. Sakkie Pretorius (Australian Wine Research Institute)

For more information and to register, go to http://jcast.csufresno.edu/ve/winemicro or call 559-278-2089.

April 12-14
License to Steal Wine Marketing Confrence Lodge & Confrence CENTER

Geneva, OH [east of Cleveland]

The state wine marketing offices of Illinois, Indiana, Missouri, New York, and Ohio present the sixth annual marketing-only conference for winery, media, tourism professionals, and economic development offices in wine regions.

For more information, go to www.NationalWineMarketing.com.

May 19
Variety Focus 2011 – Chardonnay

Freeborn Hall, UC Davis

The eighth in a series of courses to focus on the viticultural side of select wine grape varieties.

Presentations include: The Style and Character of Chardonnay – Bob Steinhauer, Grape Grower and Consultant; Chardonnay and its Clonal Development Programs in France – IFV (ENTAV), France; Sources of Chardonnay Clones, Deborah Golino – Cooperative Extension Specialist, Director, Foundation Plant Services, UC Davis; Chardonnay Clonal Research and Growing Practices in Mendocino County -- Glenn McGourty, UC Davis Extension, Mendocino and Lake Counties; Chardonnay: Twigs, Buds and Clones – Gerald Asher, Wine Writer/Editor, *Vineyard Tales: Reflections on Wine, 1996.*

For more information, visit www.extension.ucdavis.edu/wine.

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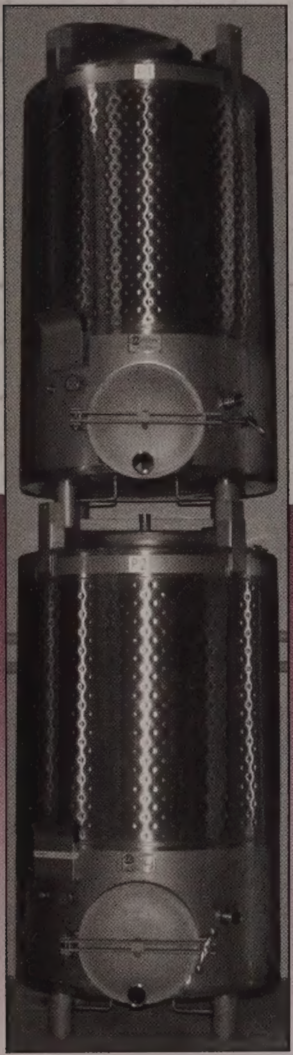

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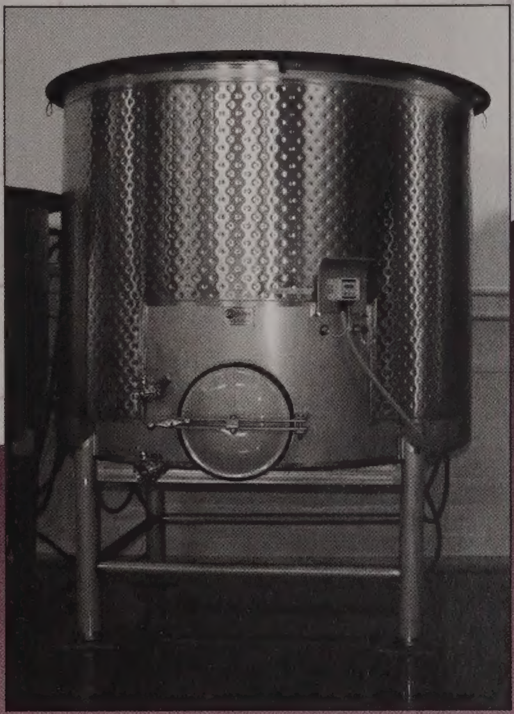

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